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BRAC Familiarization Briefing

26 February 2004

**John M. Miller, Director
U.S. Army Research
Laboratory**

**Adelphi
Laboratory
Center
Adelphi, MD**



**IMA NORTHEAST
REGION OFFICE**

Our Message Today

- ✓ **The Army Research Laboratory (ARL) conducts leading edge research that provides the Army a wide spectrum of technological capabilities for operating in a Joint environment, now and in the future.**
- ✓ **ARL has top quality scientists & engineers, partnering with their peers across the nation, with the highest density of S&Es at ALC.**
- ✓ **ARL has premier, unique laboratory facilities with DoD's largest, most comprehensive, specialized electronics materials and devices research facility at ALC.**

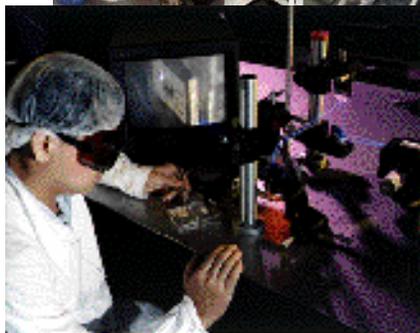
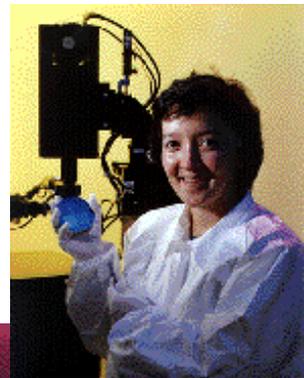
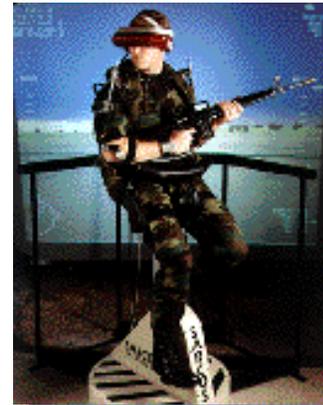




The Army Research Laboratory



Many Minds, Many Capabilities, & Multiple Pathways
Providing innovative science, technology, and analyses to enable full-spectrum operations.



Survivability

Lethality

Mobility

Power & Energy

Foundational Research



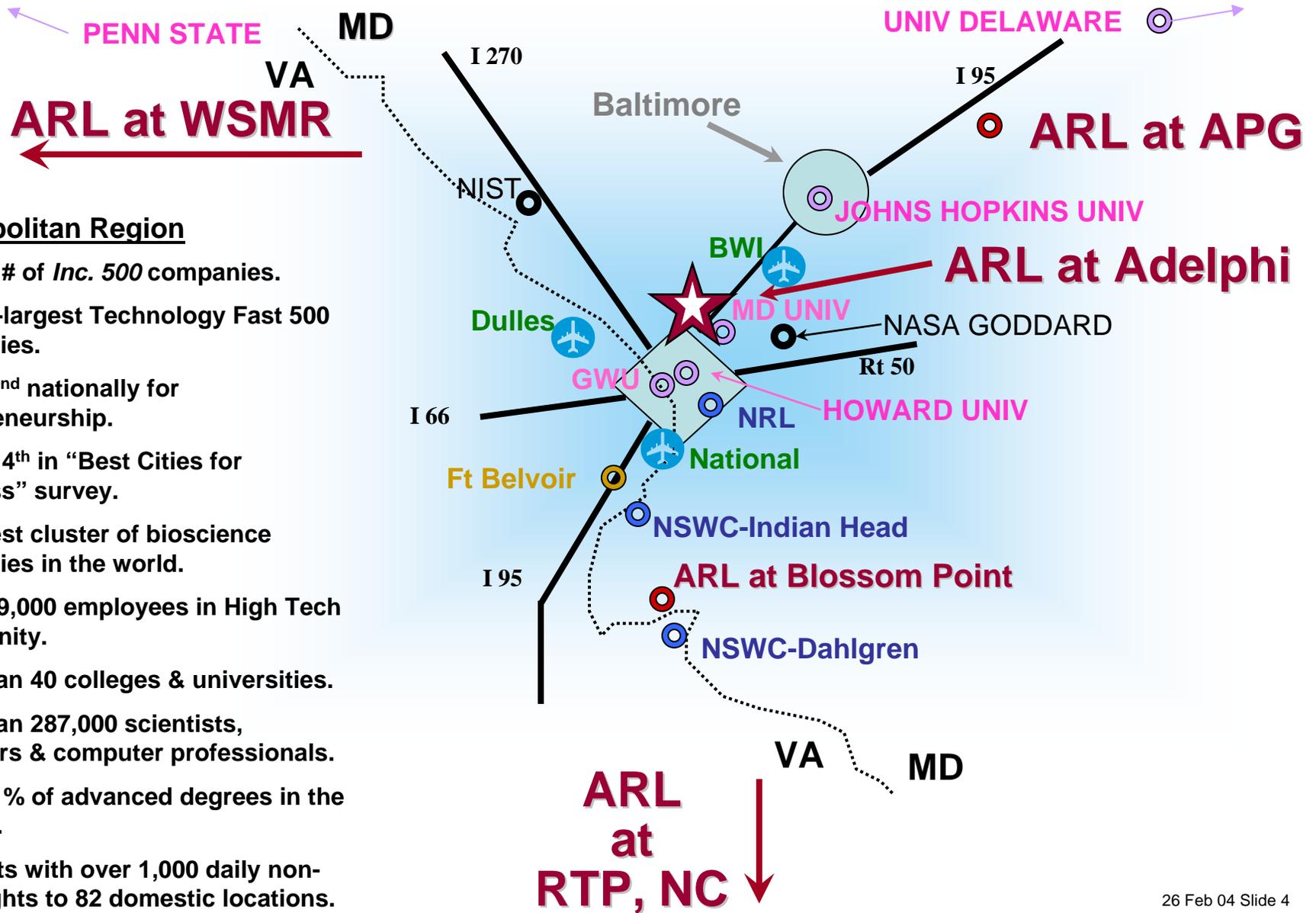
C4

Sensors & Elect.

Human Dimension

Analysis

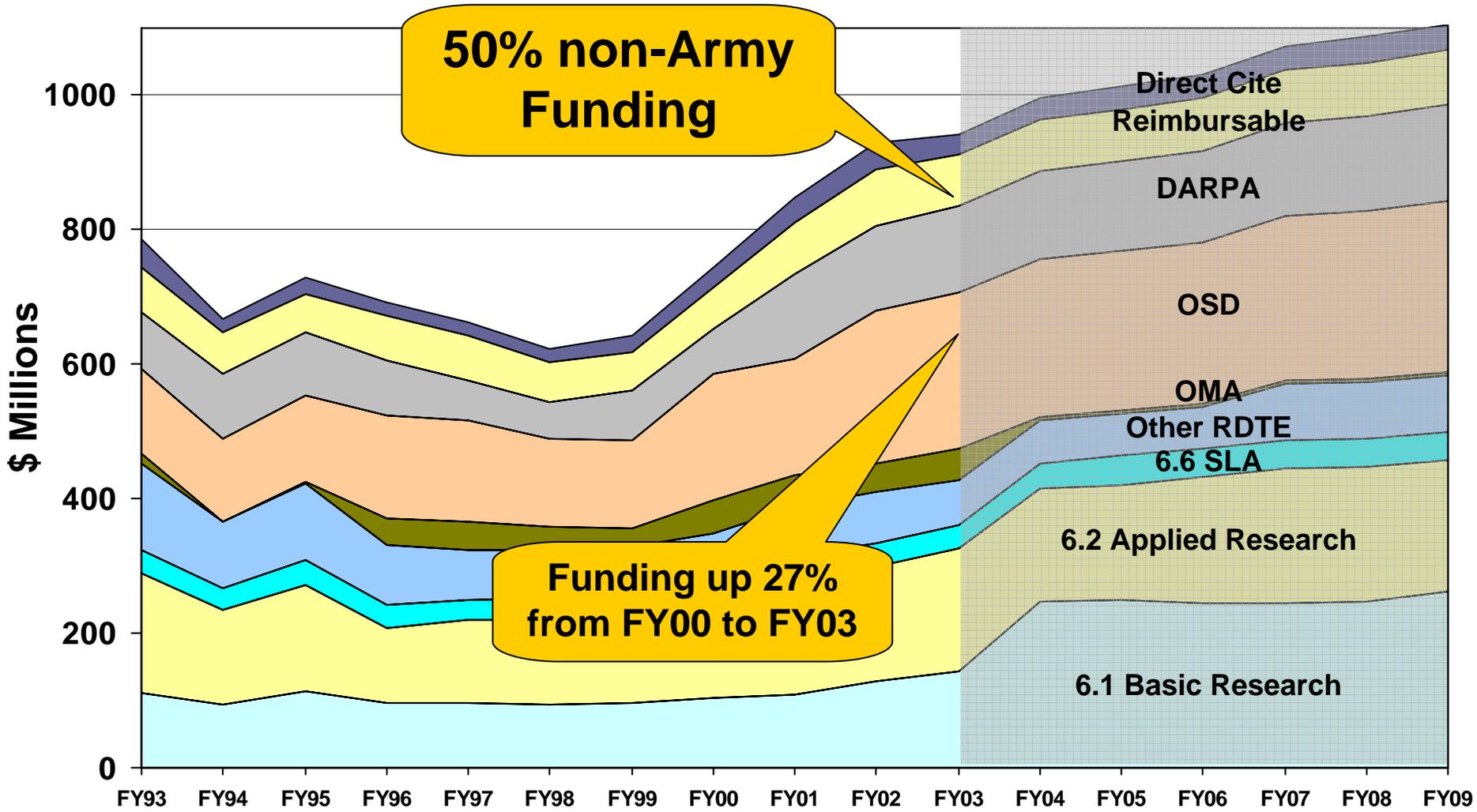
Adelphi Laboratory Center – Centrally Located Home of the Army Research Laboratory



Metropolitan Region

- Largest # of Inc. 500 companies.
- Second-largest Technology Fast 500 companies.
- Ranks 2nd nationally for entrepreneurship.
- Ranked 4th in “Best Cities for Business” survey.
- 3rd largest cluster of bioscience companies in the world.
- Over 369,000 employees in High Tech Community.
- More than 40 colleges & universities.
- More than 287,000 scientists, engineers & computer professionals.
- Highest % of advanced degrees in the country.
- 3 airports with over 1,000 daily non-stop flights to 82 domestic locations.

Army Research Lab Revenue



Our Relevant Program

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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

Foundational Research

- Nanotechnology
- Biotechnology
- Quantum Information Science
- University Research Network

C4I

- 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





Survivability



MAJOR PROGRAMS:

- *Kinetic Energy Active Protection*
- *Ballistic Protection for FCS*
- *Lightweight Appliques/Structures for Protection Against Anti-Tank Landmines*
- *Signature Management*
- *Models & Methodology to Improve Soldier & Mission Survivability*
- *Ballistic Protection for Improved Individual Survivability*
- *Enabling Materials for Soldier Survivability*
- *Contingency Armor for Abrams*

RECENT SIGNIFICANT ACCOMPLISHMENTS AND TRANSITIONS:



Stryker reactive armor designs transitioned to UDLP



Frontal, Structural, and Applique Armor Solutions transitioned to TARDEC/LSI for FCS Increment I



Field Expedient Protection for Ground Vehicles

FOR OFFICIAL USE ONLY



United Defense





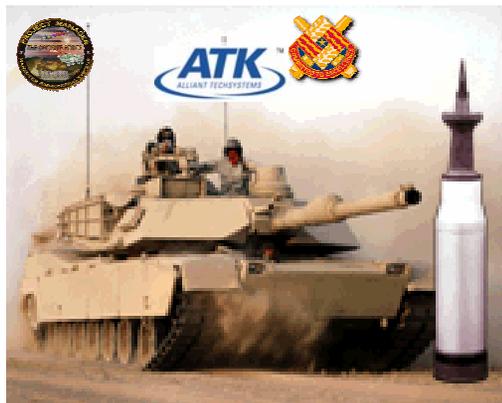
Lethality



MAJOR PROGRAMS:

- *Warheads Including Multi-Function*
- *Technologies for BLAAST & Missiles*
- *Novel Energetic Materials for the Objective Force*
- *Smart Munitions Technologies*
- *Advanced Materials for Ordnance Applications*
- *Ceramic Gun Barrel Technology*
- *Gun Barrel Straightening Initiative*
- *Electromagnetic Gun Technology*
- *High Energy Laser Technology*

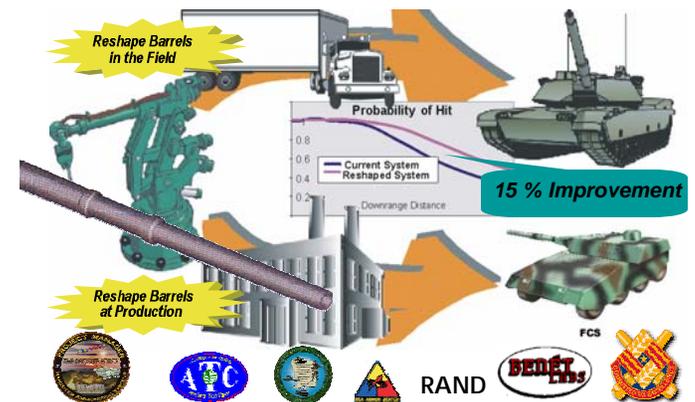
RECENT SIGNIFICANT ACCOMPLISHMENTS AND TRANSITIONS:



Innovative Technologies matured in support of M829A3 Ammunition



Improved G-Hardening of Electronics for SADARM Submunitions



Barrel Reshape Initiative – MMT Program for Tank Main Armament



Mobility



MAJOR PROGRAMS:

- *Semi-Autonomous Robotics for FCS*
- *Robotic Collaborative Technology Alliance*
- *Active Stall Control Engine Demonstration*
- *Oil-free Bearing Technology*
- *Rotorcraft Drive Systems Technology*
- *Active Twist & Soft In-Plane Rotor Technologies*



Pacbot Deployment To
Afghanistan

RECENT SIGNIFICANT ACCOMPLISHMENTS AND TRANSITIONS:



Semi-Autonomous Mobility
Technology transitioned to
TARDEC Robotic Follower ATD
& to LSI for ARV



Technology for MDARS-E
Physical Security UGV
Transitioned to PM Physical
Security



Active Twist Rotor Blades
Demonstrated in Wind Tunnel,
Reducing Flight Vibrations
Significantly



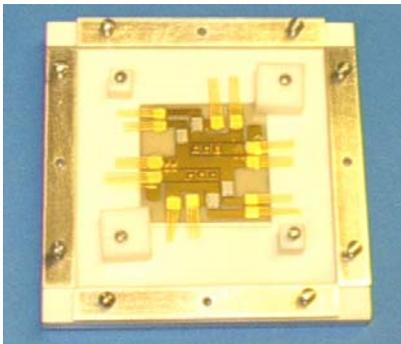
Power & Energy



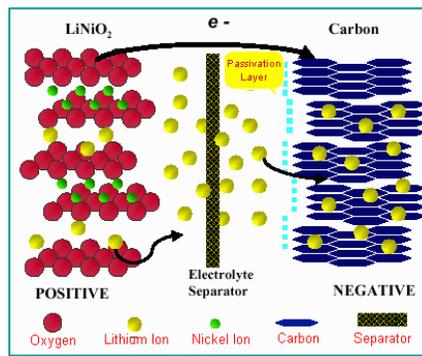
MAJOR PROGRAMS:

- Power Component Technology for FCS
- Power MEMS
- Ballistic Protection
- Hybrid Electric FCS for Increment 2
- Pulse Power for FCS
- SiC Switch
- High-Energy Density Capacitor
- High-Power Li-Ion Battery
- DARPA Nat'l Wide Bandgap Initiative – High Power Electronics

RECENT SIGNIFICANT ACCOMPLISHMENTS AND TRANSITIONS:



World's first high temperature (150° C) SiC bi-directional switch for hybrid-electric vehicle



Electrolytes and salts for extended temperature range (below -20°C) for Improved Target Acquisition System



Improved thermal design for Excalibur Thermal Battery



Analysis



MAJOR PROGRAMS:

- FCS
- Stryker
- Other Future Force Systems: High Mobility Artillery Rocket System (HIMARS), COMANCHE, Warfighter Information Network-Tactical (WIN-T)
- Current Force Systems: Army Battlefield Command System (ABCS), Apache, land Warrior, Tactical Unmanned Aerial Vehicle (TUAV)

RECENT SIGNIFICANT ACCOMPLISHMENTS :



4th Infantry Division
Identified numerous
network vulnerabilities &
recommended Improvements



STRYKER

- Identified numerous IO vulnerabilities & assisted PM in enhancing IO survivability
- Provided Live Fire Analysis: Planning, pre-shot predictions test support, post test analysis



- Future Combat Systems
- Contributed to Analysis of Alternatives Study
 - Participating in technology tradeoff decisions



Human Dimension

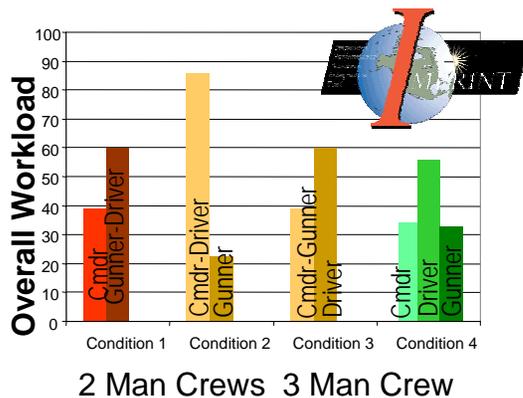


MAJOR PROGRAMS:

Systems of Systems MANPRINT RD&A for the Future Force

- Situational Understanding as an Enabler for Unit of Action Maneuver Teams
- Technology for Human Robotic Interaction in Soldier-Robot Teaming (TAR-13)
- Cognitive Engineering
- Soldier Centered Design Tools
- Advanced Decision Architecture Collaborative Technology Alliance
- Enhancing Soldier Performance in Audition, Vision, and Cognition
- MANPRINT for the Future Force

RECENT SIGNIFICANT ACCOMPLISHMENTS AND TRANSITIONS:



Task Network Modeling for 2 vs. 3 Man FCS Crews



Low Metal Mine Detection Improved From ~20% to ~90%!



Stryker T&E Support and Analyses



Sensors & Electronics



MAJOR PROGRAMS:

- RF & Electronics
 - Advanced RF Components for Future Force
 - Full Spectrum Active Protection
- Electro-Optics & Photonics
 - Sensor Optoelectronics Processing
 - Compact Laser Sources for IRCM
- Autonomous Sensing
 - Networked Sensors for the Future Force
 - Sniper Detection

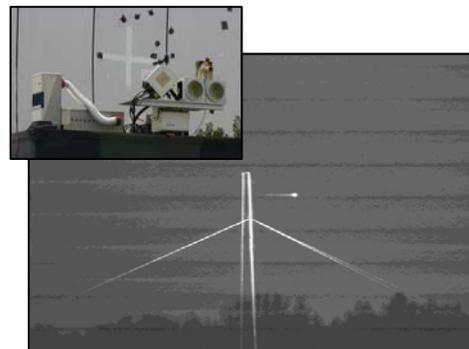


Signature Measurements and Modeling of Stryker

RECENT SIGNIFICANT ACCOMPLISHMENTS AND TRANSITIONS:



Infrasonic array at Det L in Korea



Tracking of KE Penetrator for Active Protection



Pillar Sniper Detection



Command, Control, Communications, Computers, and Intelligence (C4I)



MAJOR PROGRAMS:

- C2 in Complex & Urban Terrain
- Fusion Based Knowledge for the Objective Force
- Horizontal Fusion: Warrior's Edge and Basic Language Translation Services
- Integrated Meteorological System (IMETS) & IMETS Light

RECENT SIGNIFICANT ACCOMPLISHMENTS AND TRANSITIONS:



Integrated Meteorological System is the Army's fielded met support system



Forward Area Language Converter (FALCon)

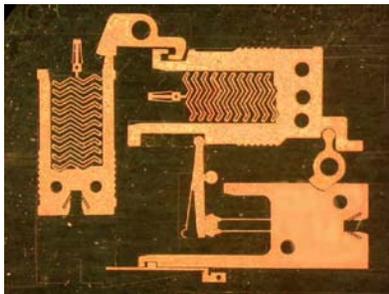


Pacbot Deployment To Afghanistan

ARDEC Fuze Group at Adelphi

- **Fuze RD&E Life Cycle**
 - Proximity Fuzes
 - Safety & Arming Devices (Mechanical and Electronic)
 - Related Technologies
 - Advanced Sensors
 - Low Cost, Small, Gun Rugged Electronic & Micro-mechanical Devices (MEMS)
 - Demolition devices
- **Concurrent Engineering for Producibility**
- **National and International Fuze Related Committees**
- **Army Fuze Safety Review Board**
- **DoD Fuze Committees**

RECENT SIGNIFICANT ACCOMPLISHMENTS AND TRANSITIONS:



MEMS team wins Army R&D Achievement Award, Dec 2003



Matériel release of M1155 Portable Inductive Artillery Fuze Setter, Jan 2004



More than 600,000 M734A1 Multi-Option/Proximity fuzes for mortars produced



Marines fire ARDEC designed mortar ammunition at Umm Qasr, Iraq, 23 Mar 2003

Our People

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ARL Civilian Personnel Profile

30 Sep. 03

1500 Technical Staff out of 2032 Civilians

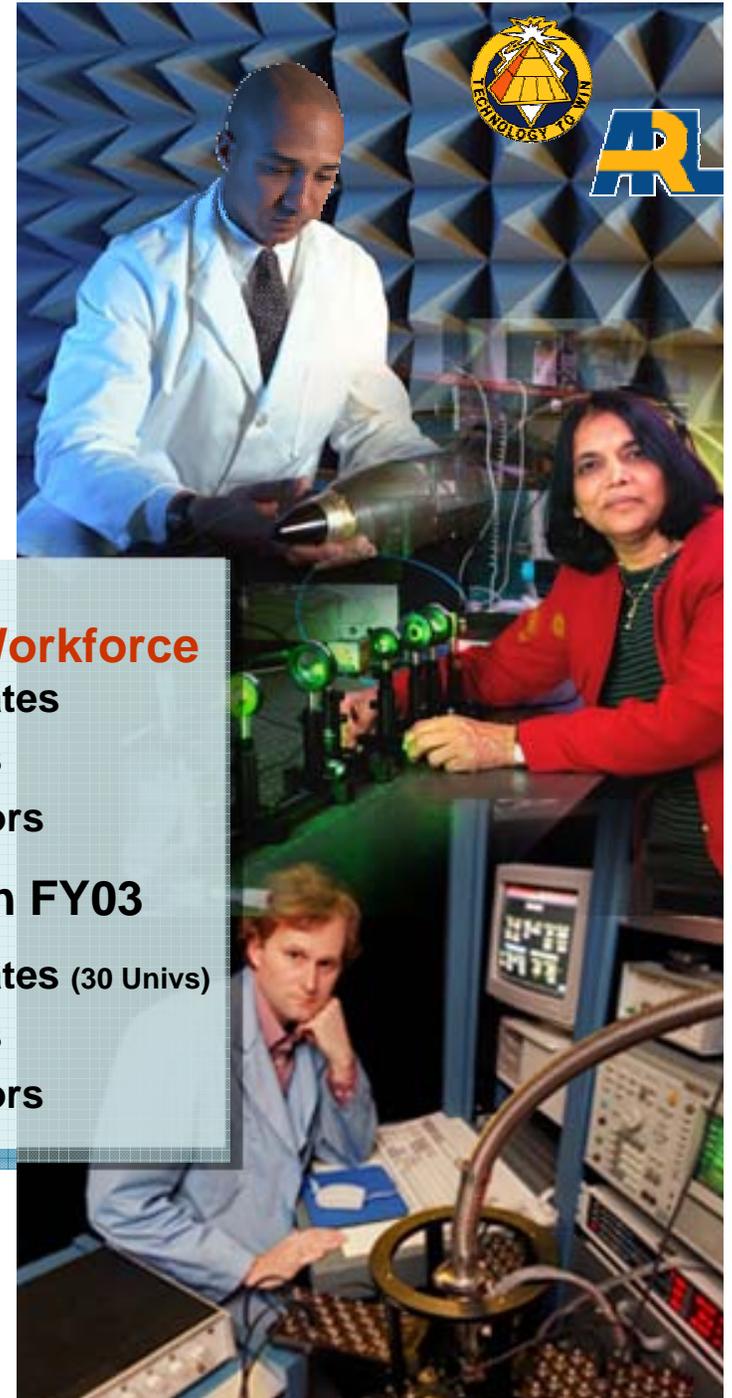
- 300 Electrical/Electronics Engineers
- 238 Physicists/Physical Scientists
- 140 Mechanical Engineers
- 110 General/Industrial Engineers
 - 61 Aerospace Engineers
 - 67 Materials Engrs./Metallurgists
 - 63 Engineering Psychologists
 - 62 Chemical Engineers/Chemists
 - 58 Operations Research Analysts
 - 72 Computer Scientists
 - 42 Mathematicians/Statisticians
 - 22 Meteorologists
 - 6 Ceramic Engineers
 - 47 Other E&S
- 212 E&S Technicians

1288 S&E Workforce

- 431 Doctorates
- 444 Masters
- 409 Bachelors

98 S&E Hired in FY03

- 43 Doctorates (30 Univs)
- 19 Masters
- 36 Bachelors



Adelphi Installation Personnel

• Army Research Laboratory	21 / 615	Military/Civilians
• ARDEC Fuze Group	39	Civilians
• National Security Agency	66	Civilians
• Installation Management Agency	133	Civilians
• Contracting Office	46	Civilians
• Nat. Cap. Region Inform. Assur. Ctr.	71 / 1	Military/Civilian
• National Guard	30	National Guard
• COMSTAR Federal Credit Union	6	Other
• Carlson Travel	1	Other
• Cafeteria	5	Other
• Walter Reed Clinic	3 / 1	Civilians/Other
• Misc. Contractors	260	Other
• CPOC	9	Civilians
• Def. Sec. Service	5	Civilians

Total Personnel ~ 1310

ARL Partnering Approach

Collaborative Technology Alliances

Centers of Excellence

Univ. Affiliated Research Centers

Multi-Univ. Research Initiatives

Single Investigators



ARL



Transition

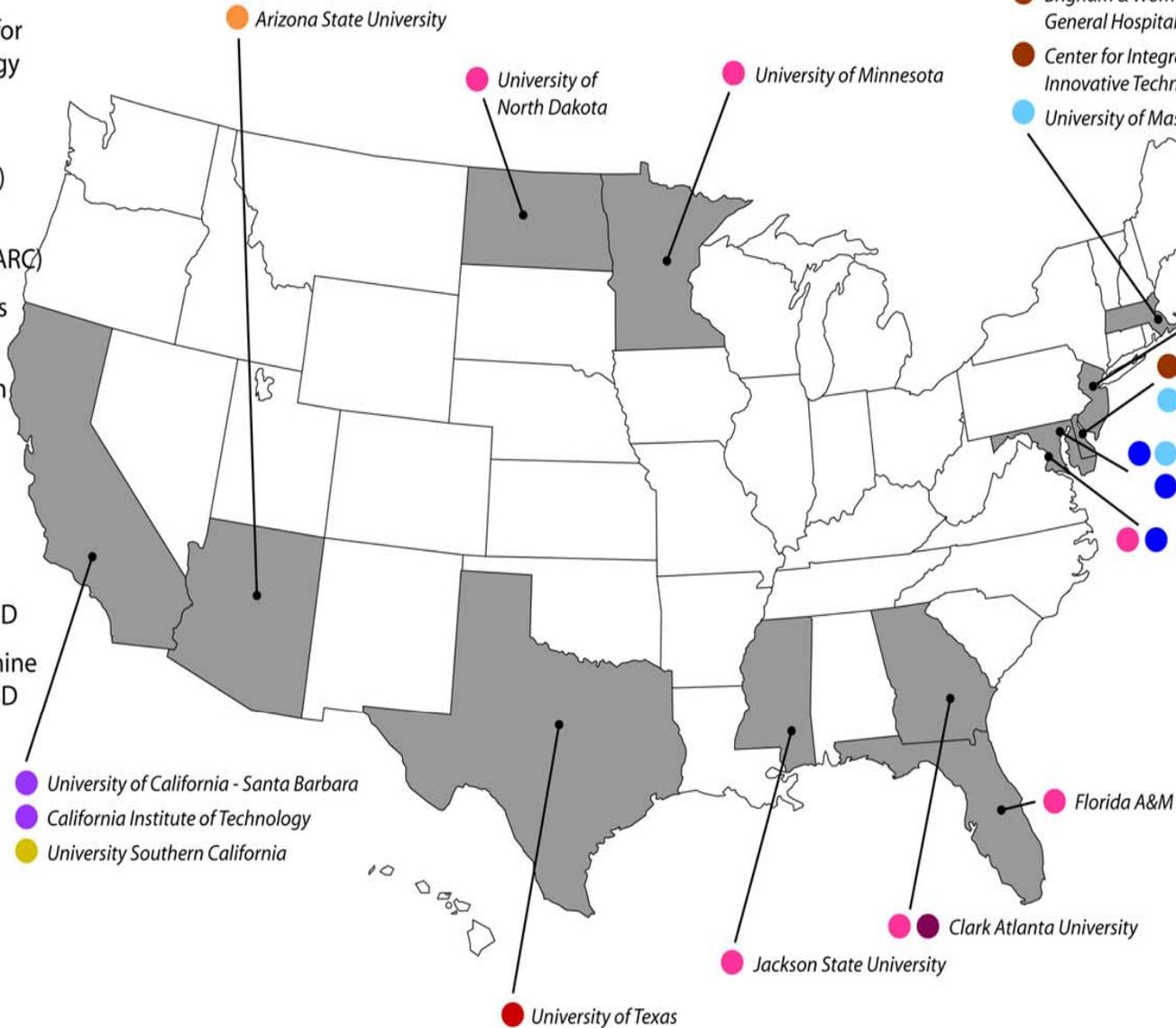
Scientific Maturity

Accelerating transition & maturity from the laboratory to the Soldier

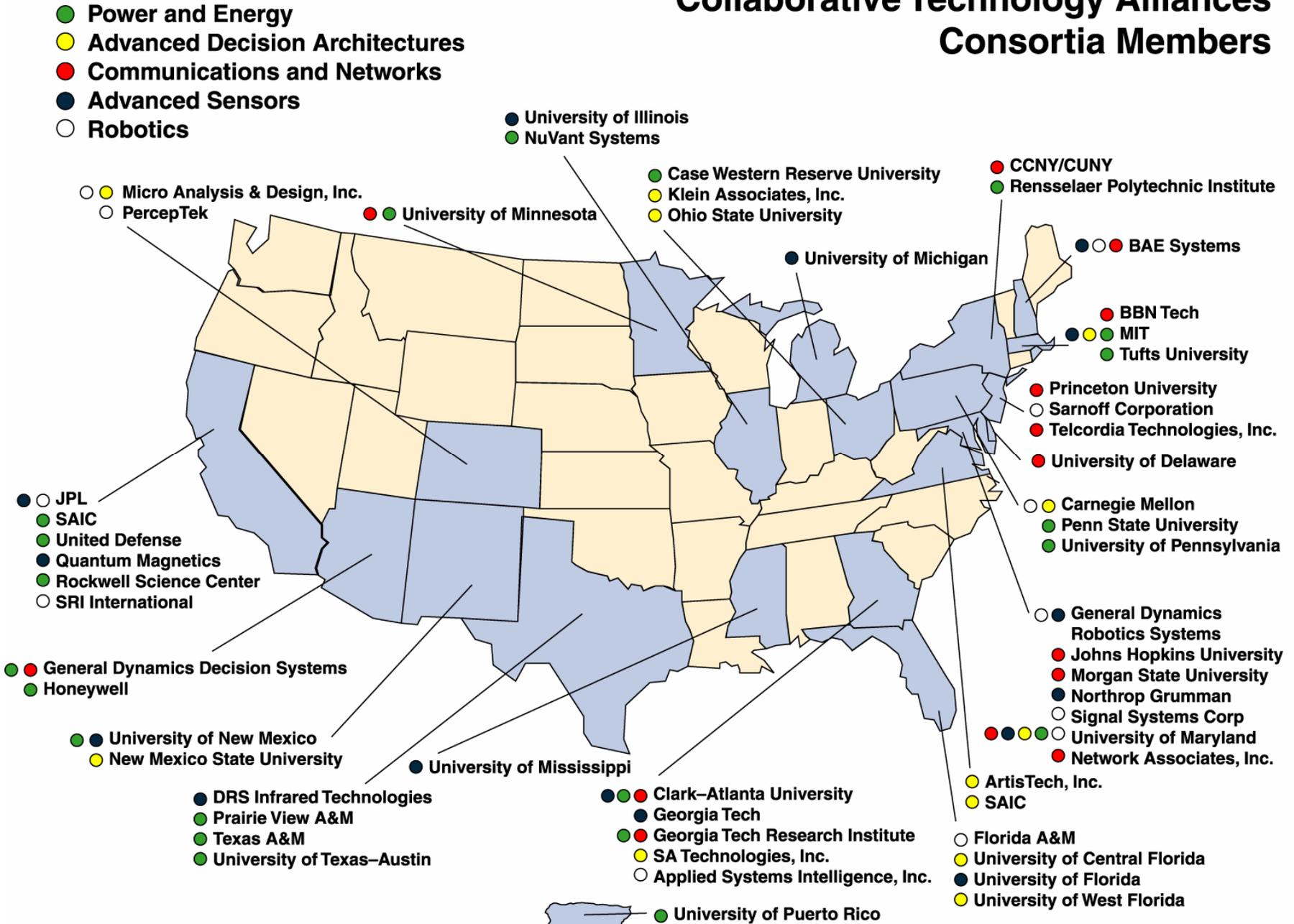
UARCs and Centers of Excellence

- Institute for Collaborative Biotechnology (UARC)
- Hypervelocity Physics & Electromechanics Research - Institute for Advanced Technology (UARC)
- Institute of Creative Technologies (UARC)
- Institute for Soldier Nanotechnology (UARC)
- Information Sciences
- High Performance Computing Research
- Materials
- Microelectronic
- Flexible Display
- HBCU/MI Centers (5 Centers in FY04) - TBD
- University Countermine Research Center - TBD

- Massachusetts Institute of Technology
- Raytheon
- Brigham & Women's Hospital, Mass. General Hospital
- Center for Integration of Medicine & Innovative Technology
- University of Massachusetts
- Rutgers University
- DuPont
- University of Delaware
- Johns Hopkins University
- University of Maryland
- ● Howard University

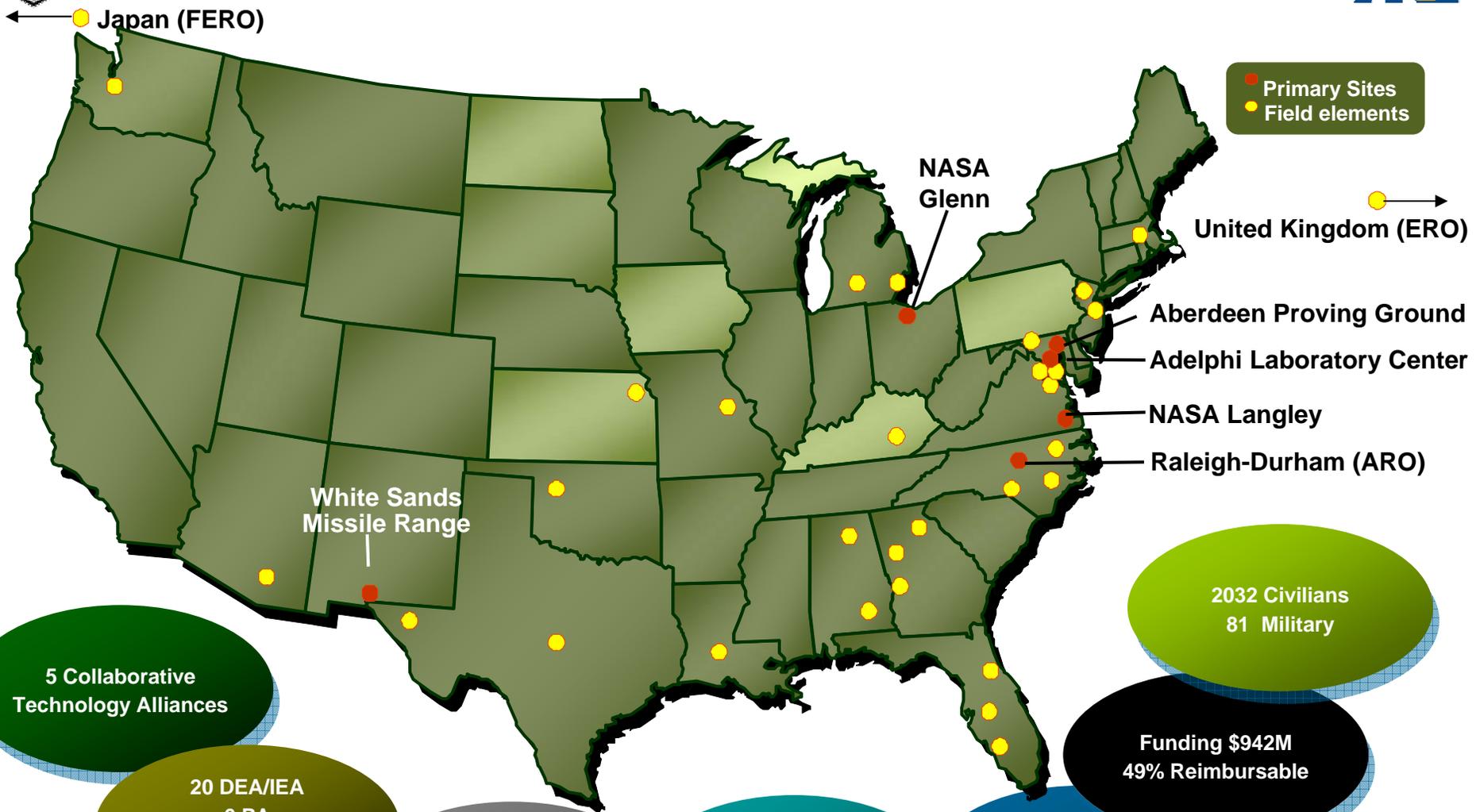


Collaborative Technology Alliances Consortia Members





Army Research Laboratory



5 Collaborative Technology Alliances

20 DEA/IEA
6 PA
7 TTCP
6 NATO

40 Phase I SBIR
49 Phase II SBIR
27 CRADAs
292 Contracts

961 Single Inv Grants
62 MURI
4 UARCs
4 COE

283 Academic Partners
In 50 States

2032 Civilians
81 Military

Funding \$942M
49% Reimbursable

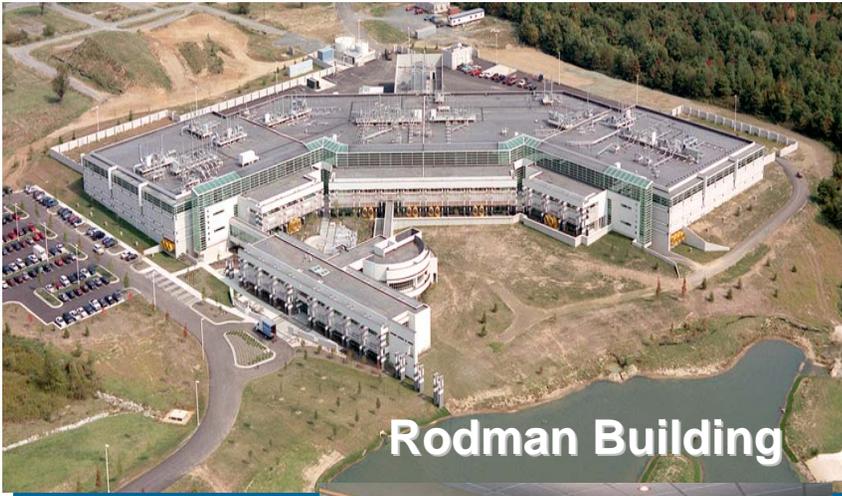
Our Facilities

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World Class Research Facilities



Rodman Building



Transonic
Experimental
Facility



Scientific
Visualization
Facility



Tactical Environment
Simulator



HPC Network
Operations And
Monitoring Center



Electron
Spectroscopy

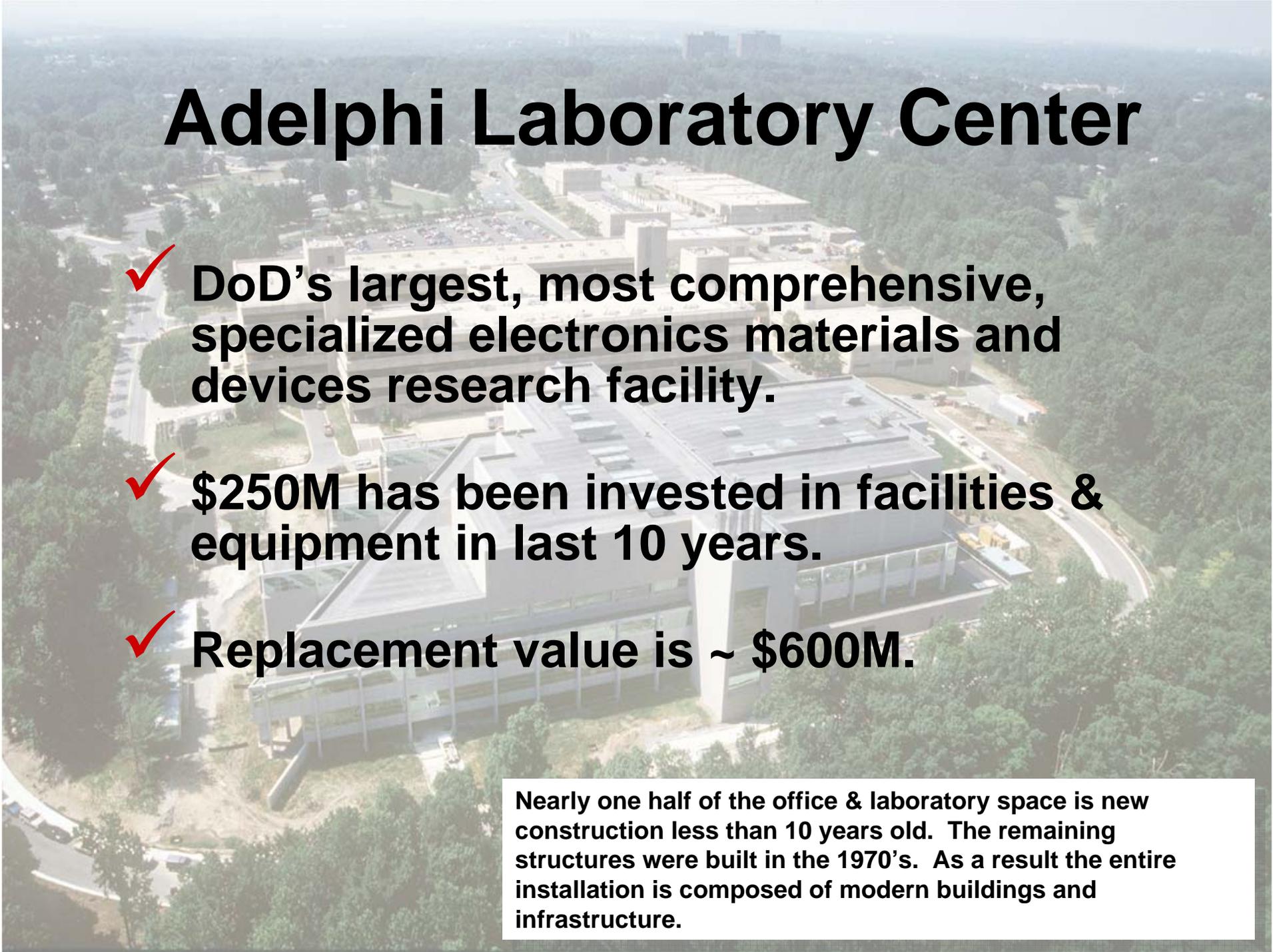


Dual Chamber
Molecular Beam
Epitaxy Machine



Zahl Building

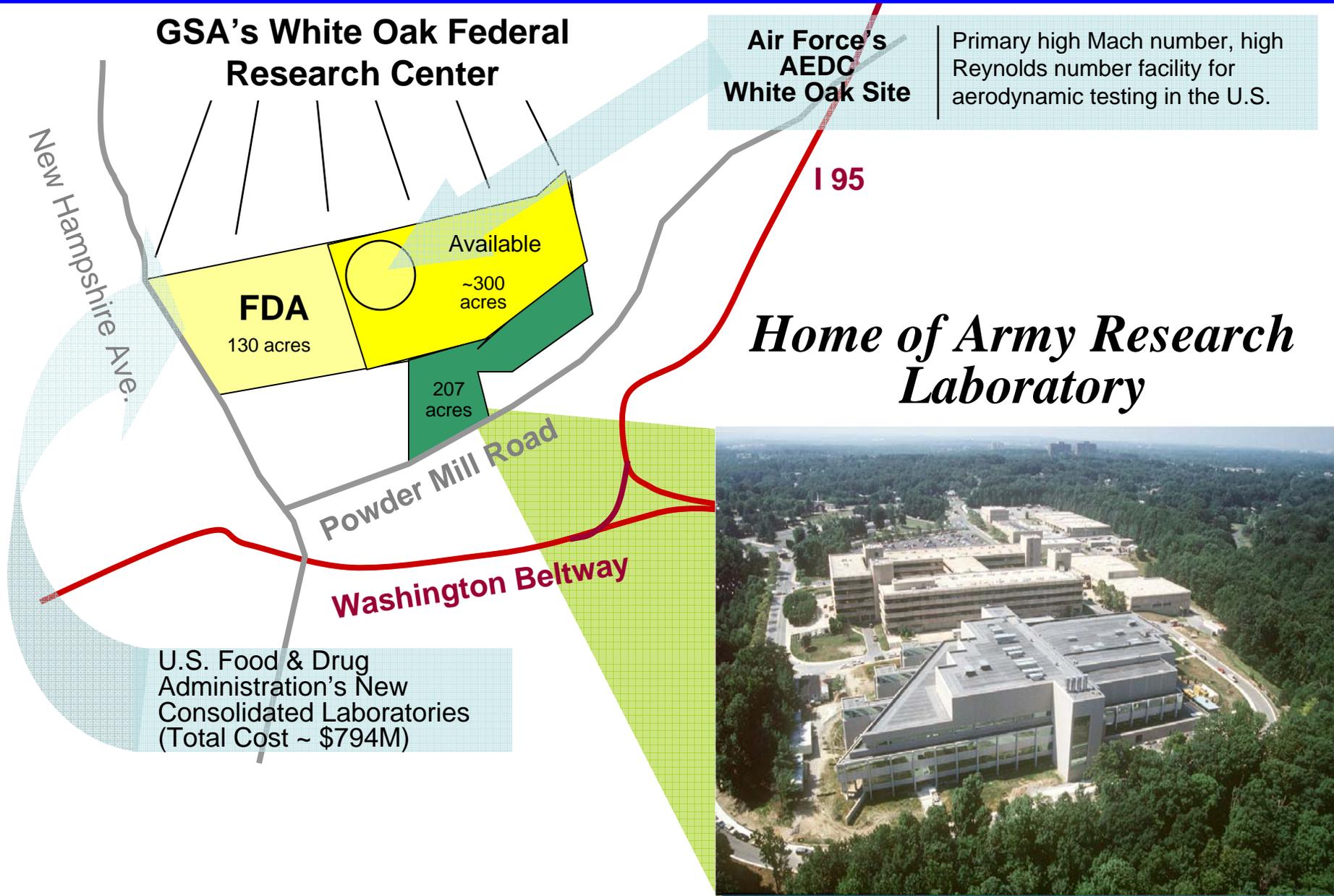
Adelphi Laboratory Center



- ✓ **DoD's largest, most comprehensive, specialized electronics materials and devices research facility.**
- ✓ **\$250M has been invested in facilities & equipment in last 10 years.**
- ✓ **Replacement value is ~ \$600M.**

Nearly one half of the office & laboratory space is new construction less than 10 years old. The remaining structures were built in the 1970's. As a result the entire installation is composed of modern buildings and infrastructure.

Adelphi Laboratory Center Adjoins White Oak Federal Research Center



Adelphi Laboratory Center

Acreage:	206.7
Prince Georges County	109.9
Montgomery County	96.8
Buildings:	36
Square Footage:	1,132,895
-Laboratory:	714,209
-Other:	418,686



**BRAC 91
additions**

Zahl Physical Sciences Lab and Harry Diamond Building (pre BRAC 91)



Electromagnetic Research Facility



Della Whittaker Building



High Bay Facility

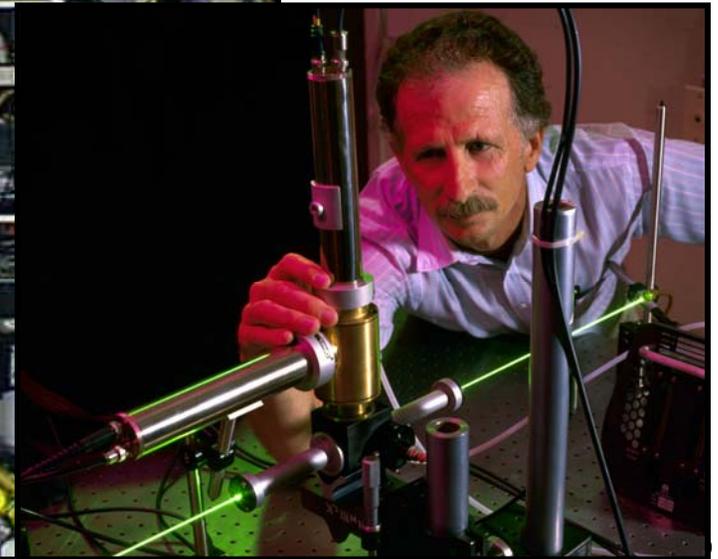
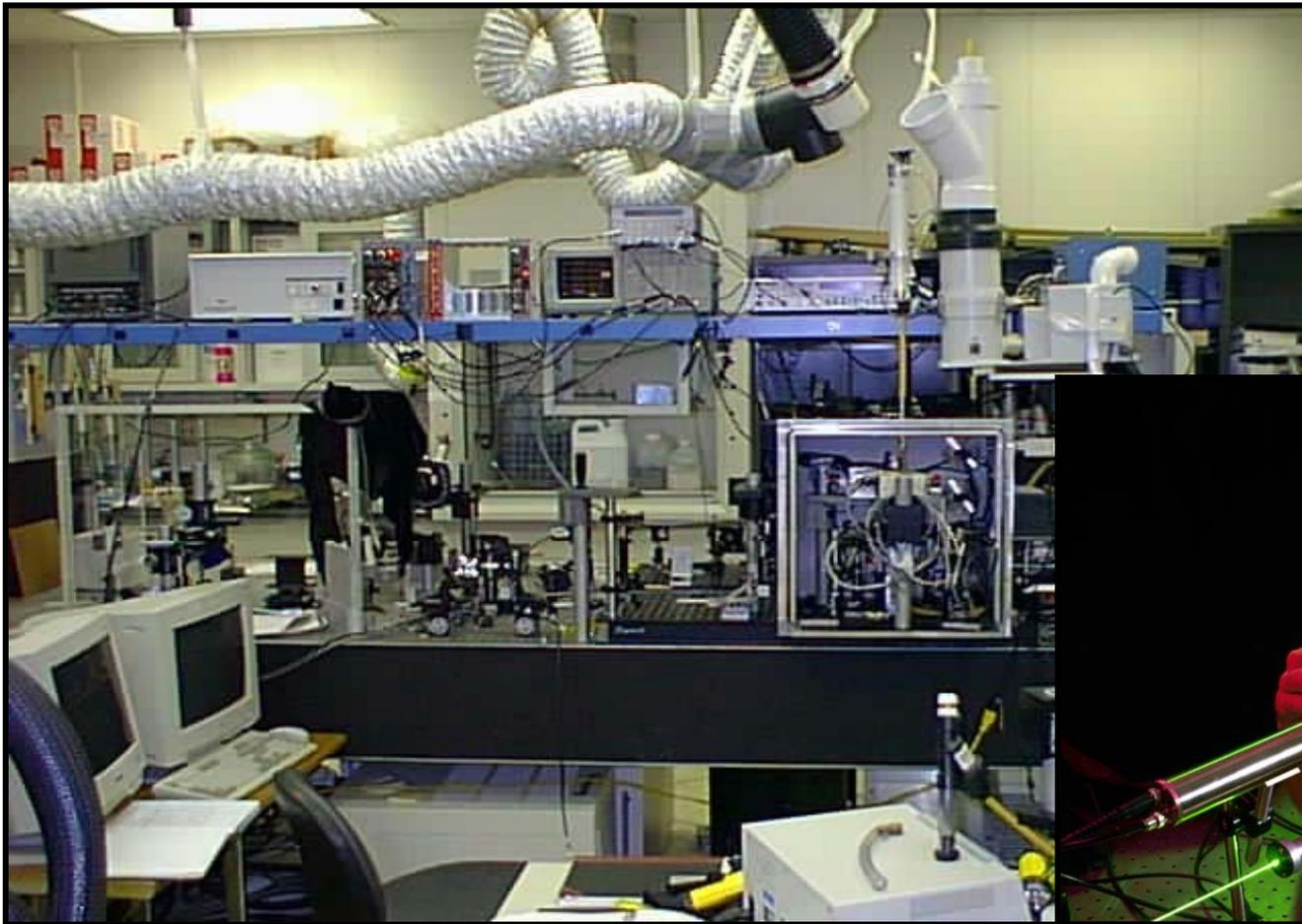
Collaboratorium

A state-of-the-art scientific visualization facility for researchers and scientists: Unclassified/classified computing/presentations; Mono/stereoscopic display; Remote graphic access; Aberdeen HPC connectivity; Video over IP.

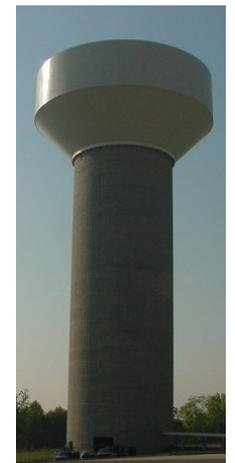


Atmospheric Aerosol Laser Laboratory

This research laboratory is used to gain knowledge and develop strategies and methods for obtaining and assimilating information about the presence, types, scattering characteristics, and dispersion of aerosols, including bio-warfare agents, fog, haze, smoke, dust, and battle-induced contaminants.



Adaptive & Intelligent Optics: Laser Optics Laboratory



Research in adaptive laser communication systems that are robust, light-weight, secure, and operate at high data rates for the Army's advanced communications and information distribution technologies.

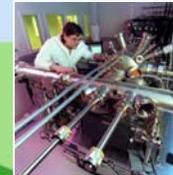
Zahl Physical Sciences Laboratory

The Zahl Physical Sciences Laboratory is a unique facility that combines, in one integrated physical structure, the full spectrum of research tools needed for specialty electronic materials, devices and sensors, their characterization, and power generation/storage. The concept is to enhance the synergy between researcher and facility by co-locating researchers with materials growth, semiconductor processing, microanalysis, and device research facilities in close collaboration with power and energy, networks, communications, application research for the Network-Centric Force.



Zahl Physical Sciences Laboratory

**Cleanroom -
Class 10 & 100
(15,000 GSF)**



II-VI Device Growth

III-V Device Growth



Wafer-to-Wafer bonding
Heterogeneous Integration
3-D Structures

Deep Anisotropic Etching

Ultralithography

Metal Deposition

Material Characterization
and Dielectric Deposition



**Epitaxial
Materials
Growth
(3,000 GSF)**

Unique facility co-locates researchers with materials growth, semiconductor processing, micro analysis, and device test facilities.



EPITAXIAL MATERIALS GROWTH FACILITIES



Epitaxial Materials Growth

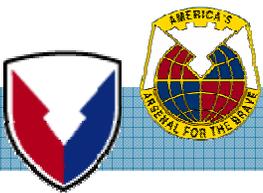


- ❑ Produces cutting-edge semiconductor materials
- ❑ Molecular Beam Epitaxy (MBE) (III-V & II-VI)
- ❑ Metal-Organic Chemical Vapor Deposition (MOCVD)
- ❑ Application – Infrared sensors, optical emitters & detectors, and electronic components

Surface Analysis Techniques:

- ❑ In-situ Ellipsometry
- ❑ RHEED
- ❑ XPS
- ❑ LEED
- ❑ AES

Army's most extensive facility of its type - contains six dedicated state-of-the-art molecular beam epitaxy and one metal-organic chemical vapor deposition system.



EPITAXIAL MATERIALS GROWTH



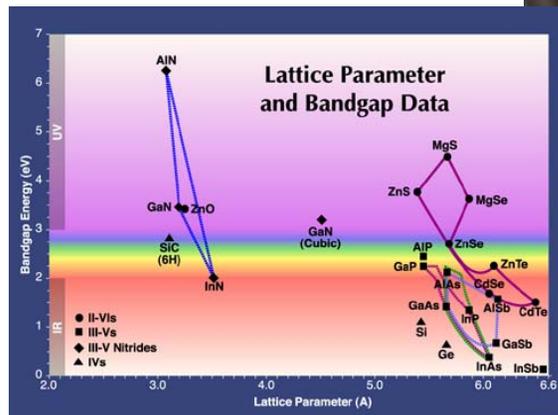
Epitaxial Materials Growth

II-VI Device Growth

Mercury Cadmium Telluride

Application

- Large Format Arrays
- Multi-color Smart Arrays
- Avalanche Photo Diode
- Single Pixel Devices



II-VI Molecular Beam Epitaxy

III-V Device Growth

Gallium-Arsenide

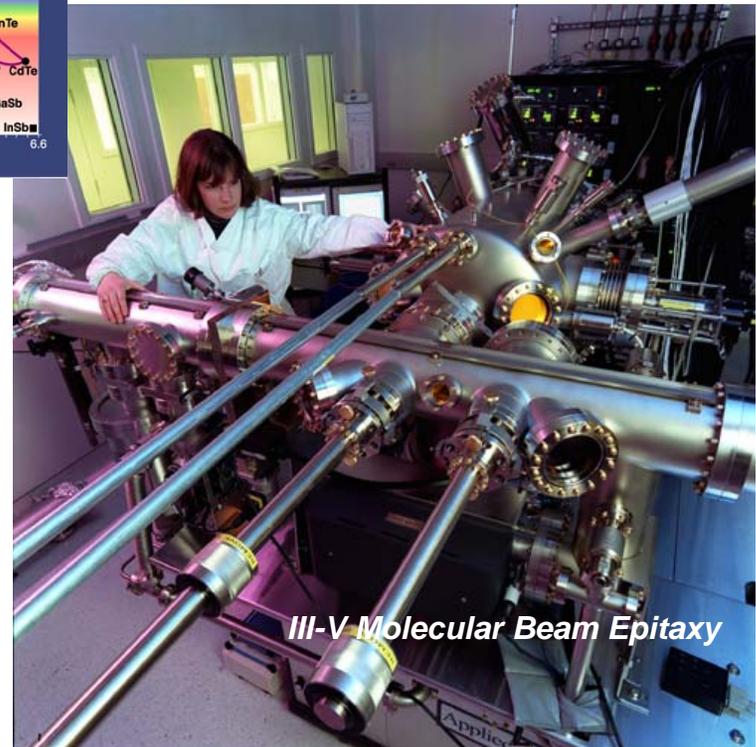
Indium-Phosphide

Gallium-Antimonide

Gallium-Nitride

Application

- Infrared, Optical and Ultraviolet Sensors
- Emitters and Detectors
- Electronic Components



III-V Molecular Beam Epitaxy

Advanced III-V and II-VI semiconductors for use in weapon systems that rely on optical detector and emitter arrays



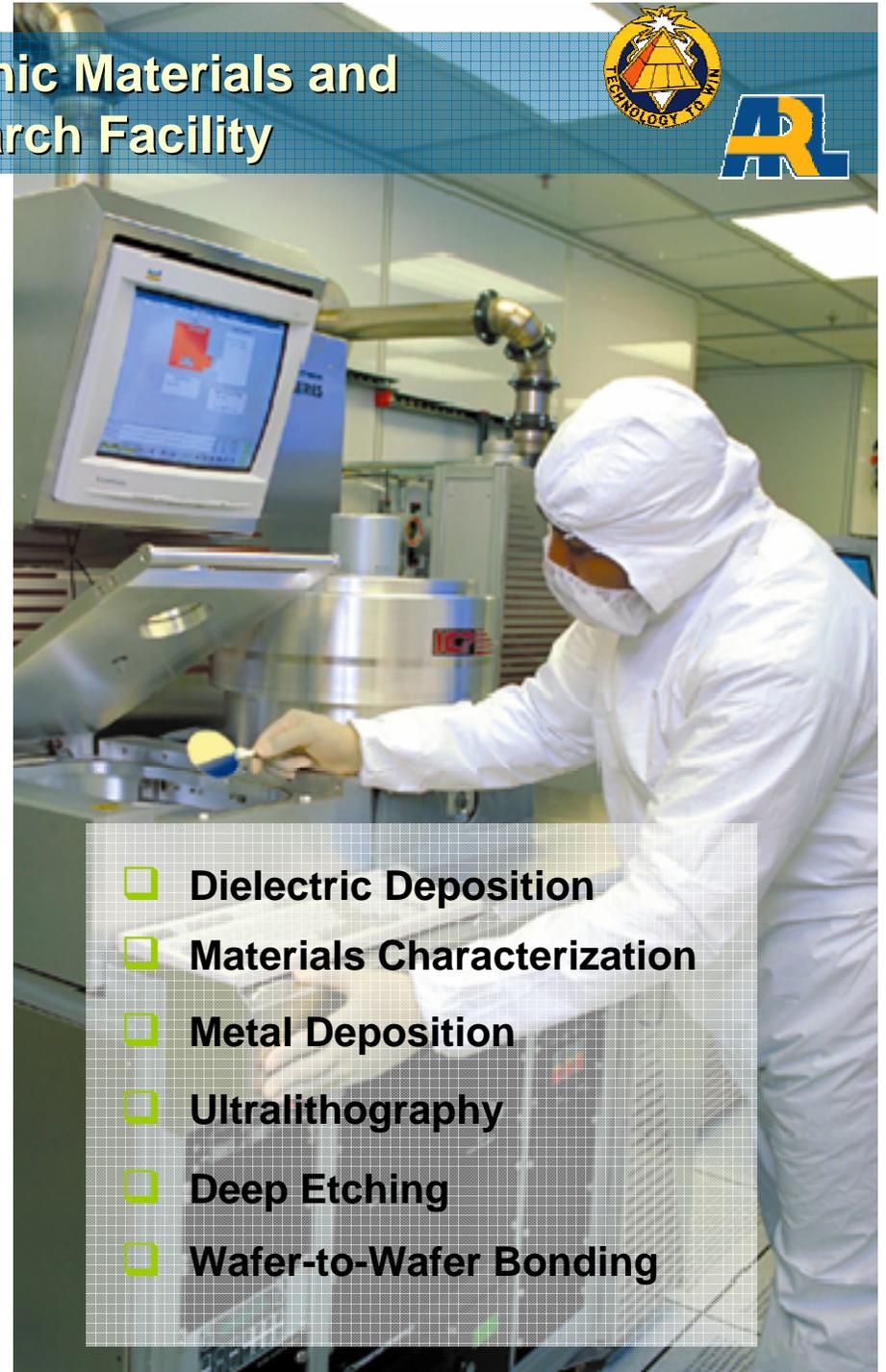
Specialized Electronic Materials and Devices Research Facility



Clean Room

- ❑ Class 100 & 10
- ❑ Military applications driven
- ❑ Niche areas
- ❑ Nano & micro scale electronic devices
- ❑ Micro-electro-mechanical systems (MEMS)
- ❑ New frontiers in silicon, PZT, SiC, gallium arsenide and other III-V and II-VI semiconductor alloys critical for Army transformation

Fabrication and development of tomorrow's military sensor technology





LITHOGRAPHY



<u>SYSTEM</u>	<u>APPLICATION</u>
Leica E-Beam Direct Write	Nano Technology
Mann 3600 Optical Pattern Generator	Photo Mask Making
Karl Suss MA6/BA6	Mask & Wafer Bond Align
Karl Suss MJB3 and Kasper 3001	Mask & Wafer Bond Align
Karl Suss ACS 200	Photoresist Processing Cluster
Axcelis / Fusion ES3	Downstream Plasma Asher
Axcelis / Fusion 200 PCU POLO	UV Photostabilizer
Tempress Wafer/Mask Cleaner	Photomask Cleaning
Headway & Solitec Photoresist Spinners, hot plates & ovens	Photoresist Coating



Leica E-Beam Nanolithography



MANN PG 3600 MEMS Mask Maker



Karl Suss MA6 Contact Lithography

Lithography for nano-technology development with resolution down to 20 nanometers



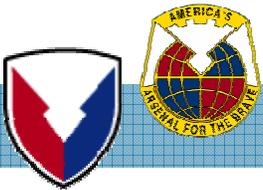
METAL AND DIELECTRIC DEPOSITION

Varian 3190 Pt Electrode Deposition



<u>SYSTEM</u>	<u>APPLICATION</u>
Sol-Gel Processing Hood and Glovebox	Sol-Gel PZT Preparation and Deposition
Unaxis VLR 700 Cluster Tool	Chamber #1: PECVD Oxide/Nitride
	Chamber #2: HD CVD Oxide
Plasma Term 790	PECVD Oxide/Nitride
Plasma Therm ECR	PECVD Oxide/Nitride
Unaxis Clusterline 200 with integral RTA	Dielectric Sputter System PZT, AlN, ZnO
Metron/Novellus 3290	Metal Sputtering Al
Varian 3190	Metal Sputtering Pt,Ta,Ti
CVC-610 Sputtering System	Au, Al, Ti, Ta, Ni, metals
CHA Industries	Six-Pocket E-beam Evaporation Si, Ti, Au, Ni, Al, Pt, Cr, Ge, Ag

Focus on non-standard material capabilities typically not found in a commercial IC fabrication facilities or foundries.



ETCHING



<u>SYSTEM</u>	<u>APPLICATION</u>
Unaxis VLR 700	Chamber #1: Silicon DRIE
	Chamber #2: Metal ICP Etch
	Chamber #3: Oxide/Nitride ICP
Plasma Therm 770	Silicon DRIE
Xactix XeF ₂ Etcher	Isotropic Si Etching
Oxford Plasmalab 100	Evaluating Cryogenic Etching
Trion Tech Ion Etcher	Pt and PZT Etching
STS Adv. Oxide Etcher	Deep Oxide Etching
Anatech MP1000	Barrel Etcher
Metroline M4L	Resist/Oxide/Nitride Etching
Plasmalab RIE	Oxide/Nitride RIE
LAM 590	Oxide/Nitride RIE
Plasma Therm 720	Multipurpose RIE
Commonwealth Ion-mill	Argon Ion Milling
Plasma Therm ECR	SiC Etching & Oxide/Nitride



Unaxis VLR 700 Etch Cluster System



Xactix XeF₂
Isotropic Si Etching

Facilities and processes available to other government and non-government agencies



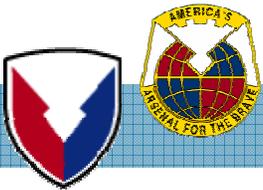
THERMAL PROCESSING AND WAFER BONDING



<u>SYSTEM</u>	<u>APPLICATION</u>
BTU/Kokusai Furnaces (7 Tubes)	LPCVD Poly-Si & Nitride, LTO, Wet and Dry Thermal Oxidation, Anneal
BTU/Kokusai Furnace (1 Tube)	Fusion Bonding
Karl Suss SB6	Wafer-to-Wafer Anodic, Eutectic and Fusion Prebond
Karl Suss MA6/BA6	Wafer-to-Wafer Align & Pre-Bond
EVG IR Inspection	Wafer-to-Wafer Bond Inspection
Ag 410 Heat Pulse	Rapid Thermal Anneal III-V Material Systems
Ag 610 Heat Pulse	Rapid Thermal Anneal Oxide/Nitride
Ag 610 Heat Pulse	Rapid Thermal Anneal of PZT
CVC RTA	General Rapid Thermal Anneal (Ar, O ₂ , H ₂ N ₂)



ARL is the only government facility currently participating as part of the MEMS Exchange which makes facilities available to any U.S. Technology Developer on a reimbursable basis



MATERIALS AND MEMS CHARACTERIZATION



<u>SYSTEM</u>	<u>APPLICATION</u>
J.A. Woollam M2000F	Multi- wavelength / Multi-Angle Ellipsometer
KLA-Tencor P-15	Surface Profilometer
Hitachi S-4500 II	Field Emission SEM
Tencor FLX 2908	Stress Measurement
Prometrics Four Point Probe	Resistivity Measurements
Compumetrics Inst. Inspection Microscope	Line Width measurements
Nanometrics 3000 PHX	Resist/Oxide Thickness
2 Leitz Ergolux Microscopes	Device / Lithography Examination
MMR Vacuum Probe Station	Pressure and Temperature Device Testing
Polytech PI Scanning Laser Doppler Vibrometer	Z-axis displacement and velocity measurements



J.A. Woolen
Multi-angle/wavelength Spectroscopic Ellipsometer

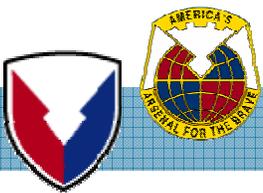


Nanospec Film Measurement System



Tencor FLX 2908 Stress Gauge

Focus in nanoscience, microelectromechanical systems, wide-bandgap electronics, and optoelectronics



MICROANALYSIS FACILITIES



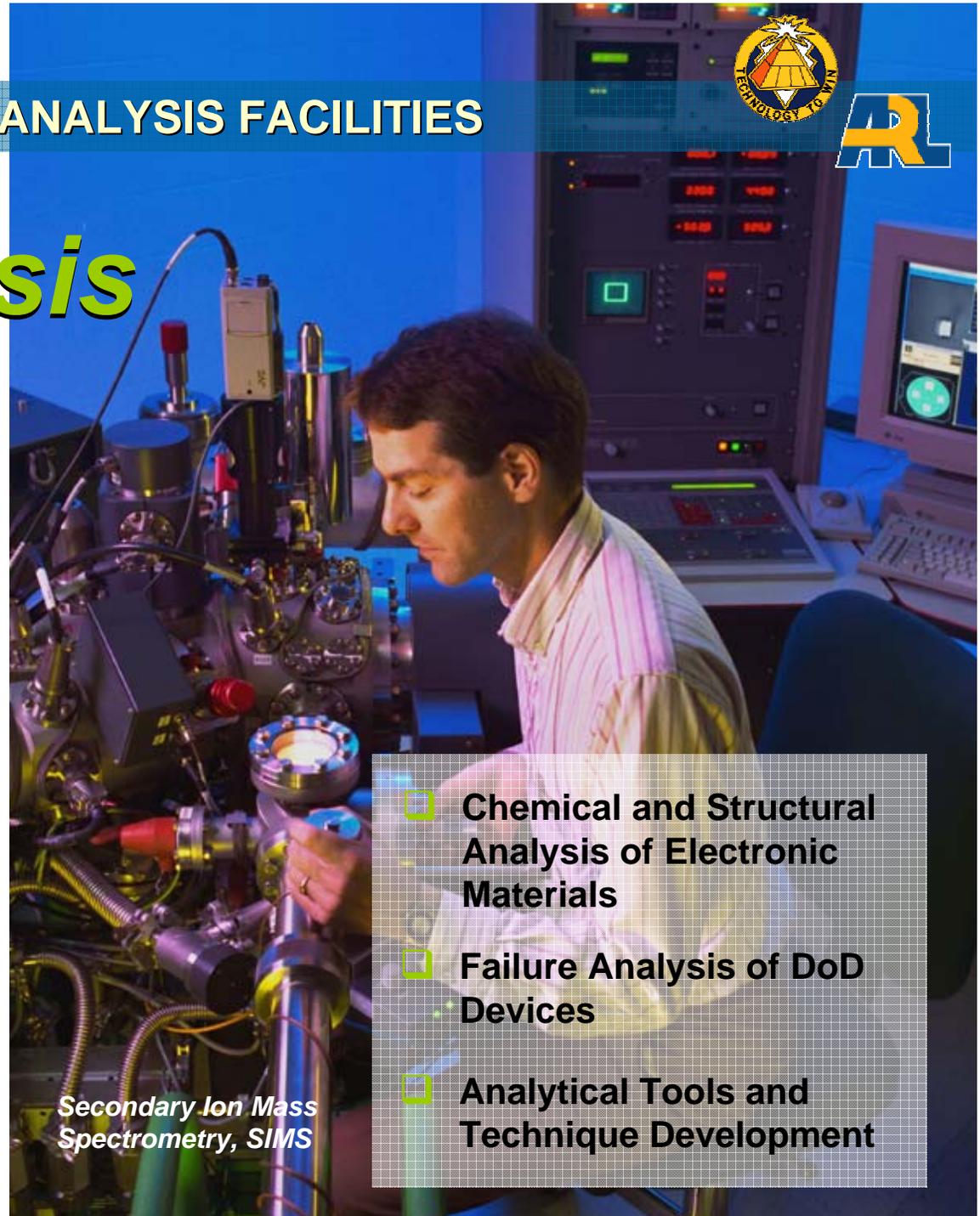
Microanalysis

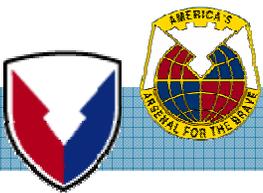
- ❑ Precisely control material properties
- ❑ Guide fabrication process and correlate composition with performance
- ❑ Microanalysis and fabrication capability under one roof
 - Accelerates device development
 - Faster transition
 - Better reliability of electronics

Provides the DoD with a fully integrated capability for failure, chemical and structural analysis of electronic materials and devices.

Secondary Ion Mass Spectrometry, SIMS

- ❑ Chemical and Structural Analysis of Electronic Materials
- ❑ Failure Analysis of DoD Devices
- ❑ Analytical Tools and Technique Development





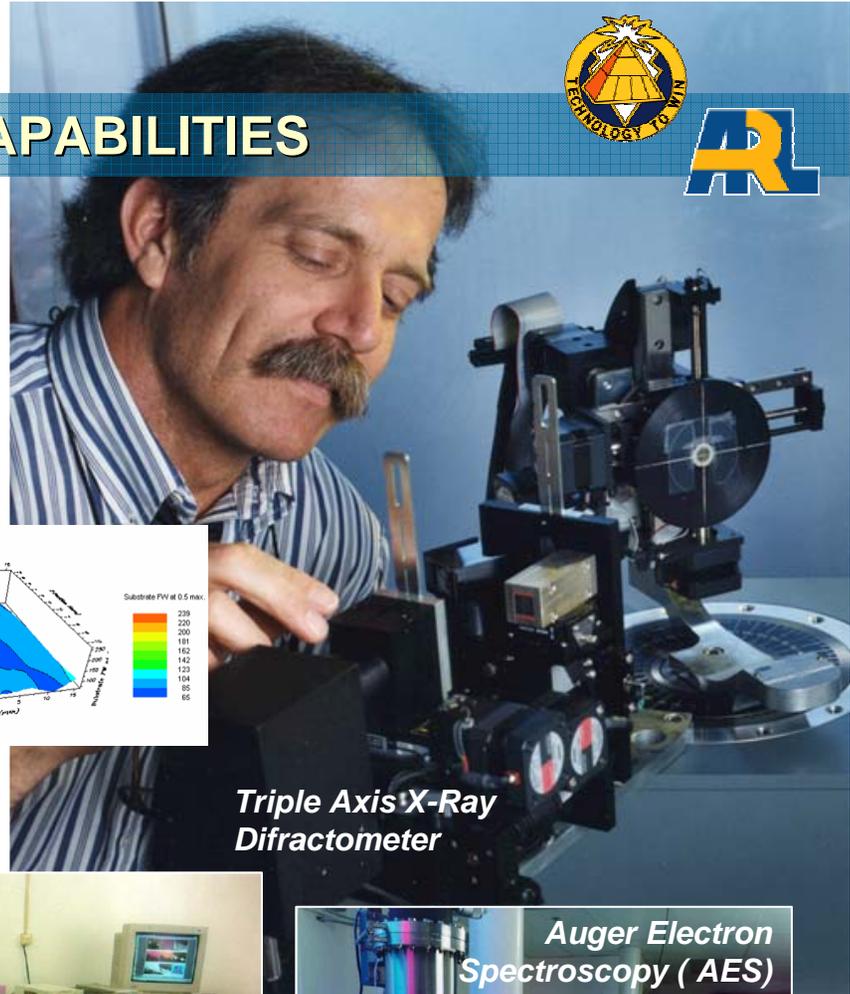
MICROANALYSIS CAPABILITIES



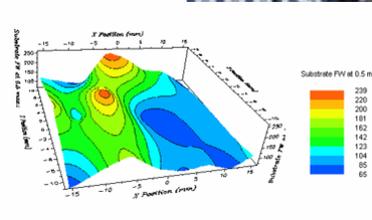
Chemical and Structural Analysis of Electronic Materials

Assess physical, chemical and structural properties of electronic materials and layers

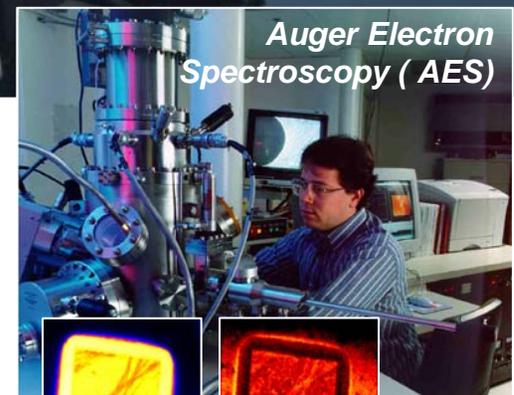
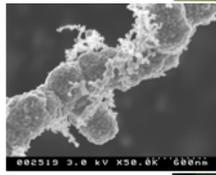
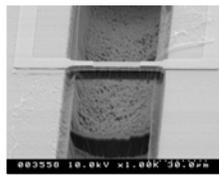
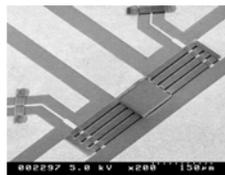
- Transmission Electron Microscopy
- Glow Discharge Mass Spectrometry
- Atomic Force Microscopy topography
- Inductively Coupled Plasma Mass Spectrometry
- Fourier Transform Infrared Spectroscopy
- Organic Chemical Characterization
- Micro Raman Spectroscopy



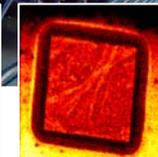
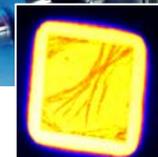
Triple Axis X-Ray Diffractometer



Scanning Electron Microscopy (SEM)



Auger Electron Spectroscopy (AES)



Characterization measurements reach resolution on the atomic scale and elemental detection sensitivities to parts per billion levels.



MICROANALYSIS CAPABILITIES

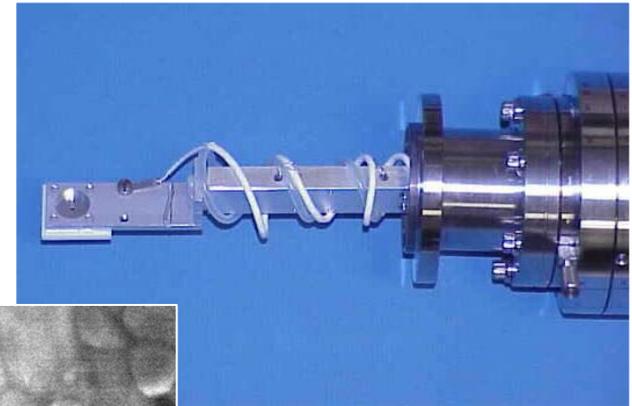
Research and Development of New Analytical Tools and Techniques

- ❑ Precisely control, and measure the chemical and physical properties of materials
- ❑ Development of better characterization techniques and methodologies



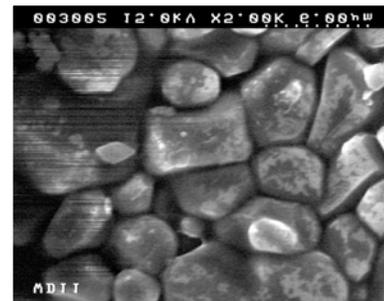
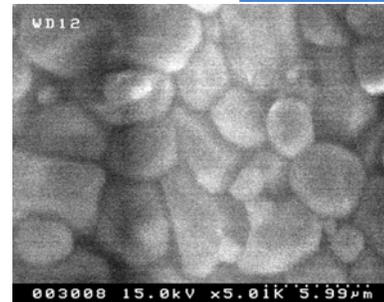
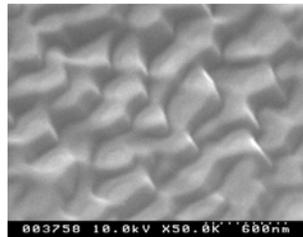
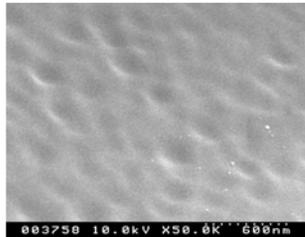
Novel implantation

- Unique ion source to implant species within a matrix
- Quantify materials in nonstandard matrices
- Method to dope semiconductors

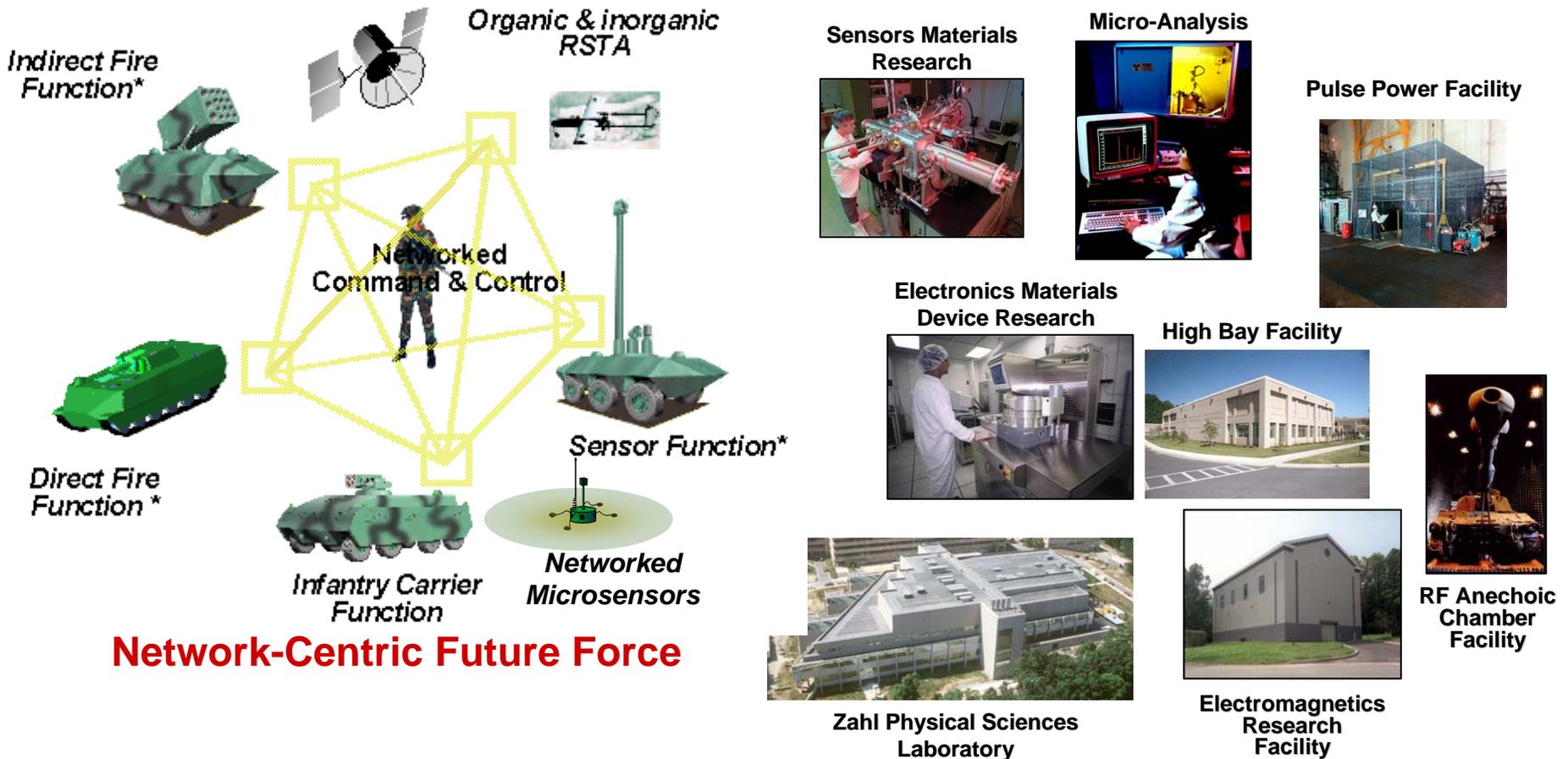


Rotational Profiling

Improves precision so vertical layers can be differentiated



Adelphi Facilities



The Adelphi Laboratory Center uniquely supports the Army's transformation towards joint network-centric warfare. It integrates, at a single R&D site, the full spectrum of technology associated with specialty electronic materials, devices, sensors, power & energy, networks, and communications that will address the requirements of network-centric warfare for the Striker Brigades and Future Force.



Army Research Laboratory Adelphi Laboratory Center



- ✓ ***Located in an collaborative-rich area with nationally ranked universities, laboratories, and companies.***
- ✓ ***Professional staff highly recognized and integrated with their peers.***
- ✓ ***Unique, state-of-the-art laboratory facilities and equipment.***
- ✓ ***Able to attract and retain a team of top quality scientists and engineers.***

Uniquely positioned to accelerate innovative research & technology to Army & DoD applications.