



Advanced Electronics Col 2018 Overview

Dr. Romeo del Rosario

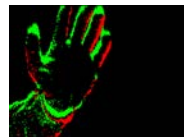
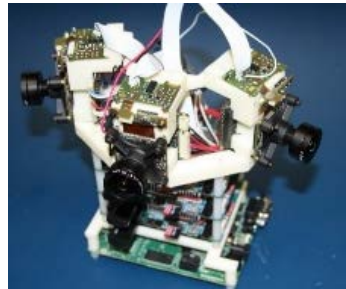
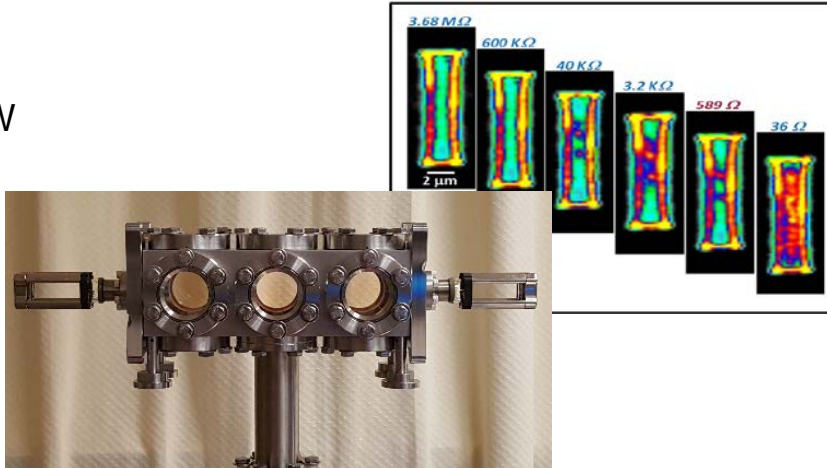
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Strategic Priorities



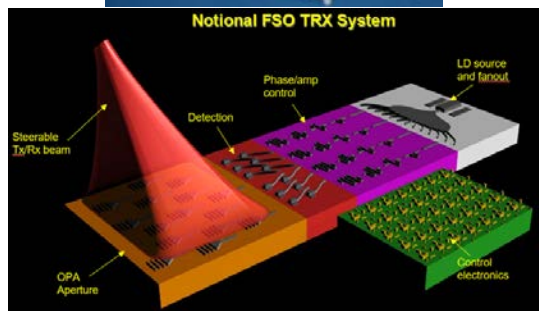
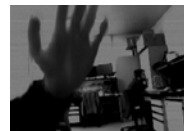
- Provide electronic materials, devices and components that ensure ownership of the electromagnetic spectrum for Sensors, Electronic Warfare, Directed energy, and Cyber-EW
- Develop quantum S&T for revolutionary performance after OSD's Quantum Science and Engineering Program (QSEP) ends:
 - Sensing
 - Assured references – position, navigation and timing (PNT)
 - Networks & Computational applications
- Understand and exploit electronics for artificial intelligence (AI), machine learning and robotics
 - Neuromorphic processes and sensors
 - Advanced power electronics and energy delivery
 - Autonomous operation
- Accelerate technologies that integrate the use of photons and electrons within a circuit or microsystem (integrated photonics) to significantly advance miniaturization and performance
- Identify and develop lasting and affordable solutions to provide trusted and assured electronic components and access to leading edge integrated circuit technologies



proposed

Novel methods of sensing and understanding

traditional



Share and evolve best practices



Taxonomy

- **Electronic Materials**
 - Growth and Characterization Technologies
 - Electro-Optics
 - Flexible Electronics and Displays
 - Micro/Nano Electronics
 - RF Components
 - Power Electronics
 - Synthesis
 - Additive Manufacturing
- **RF Components**
 - Antenna Support
 - Control Components and Filters
 - Sources - Solid State
 - Sources - Vacuum Electronics
 - Sensors - Solid State
 - Sensors - RF Photonic
 - Electromagnetic methods and techniques
 - Heterogeneous Integration
 - Manufacturing Technologies
- **Power Electronics**
 - Wide Bandgap Semiconductor Devices
 - Silicon Devices
 - Power Integrated Circuits and Components
 - Enhanced Thermal Management
 - Packaging
- **Digital, Analog and Mixed Signal Integrated Circuits**
 - Custom Manufacturing
 - Design
 - Leading Edge Digital, Analog, and Mixed Signal Integrated Circuits
 - MEMS and NEMS
 - Heterogeneous Integration
 - 3D/2.5 Integrated Circuits
 - Neuroelectronics components
- **EO/IR Components**
 - Display Components
 - Sources - Lasers
 - Sensors - Focal Plane Arrays
 - Integrated Photonics
 - Sources - LEDs
- **Cross Cutting Technologies**
 - Anti-tamper
 - Radiation Hardening
 - Trust, Assurance, and Availability - IV&V
 - Trust, Assurance, and Availability - Supply Chain
 - Reliability
 - EMI/EMC/EMP Hardening
 - Counter DEW Hardening
 - Computational Methods
- **Quantum Based Components and Technologies:**
 - Information
 - Sensing
 - Computing
 - Networking
 - Technology Platforms - Solid State
 - Technology Platforms - Superconducting
 - Technology Platforms - Ion
 - Technology Platforms - Atom
 - Technology Platforms - Optical



Major Changes



- **Investment profile - Significant changes in FY18**

- DARPA Electronics Resurgence Initiative (ERI) - AE taxonomy bin Digital, Analog, Mixed Signal ICs
- DMEA 6.3 investment more than doubles in AE first tier taxonomy Digital, Analog, Mixed Signal ICs in two second taxonomy tier bins:
 - Custom Manufacturing
 - Leading Edge Digital, Analog, and Mixed Signal Integrated Circuits

- **Updates to major Service investments**

- Air Force, Army, and Navy investments relatively constant-total \$'s down slightly for all three in PB18
- Chief of Naval Research has issued new S&T strategy-NRE Framework with emphasis on speeding technology innovation to the warfighter
- Chief of Staff of the Army issued new guidance to focus S&T on Modernization Priorities:
 - Long Range Precision Fires
 - Next Gen Ground Combat Veh.
 - Future Vertical Lift
 - Network/C3I
 - Air & Missile Defense
 - Soldier Lethality
 - Precision Navigation and Timing
 - Synthetic Training Environment

- **Roadmaps Implemented in the updated taxonomy**

- Key features of roadmaps plotted at first tier of taxonomy
- Refine to provide greater granularity in FY18 for second tier of taxonomy

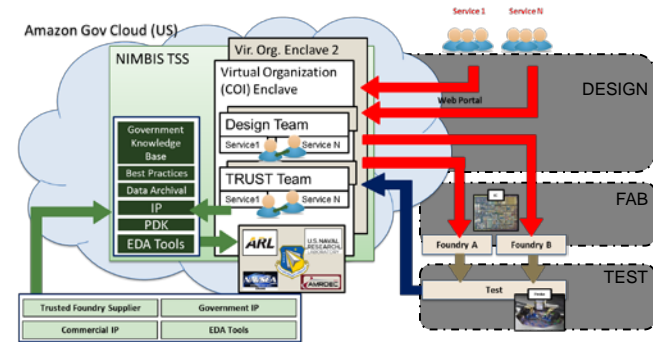
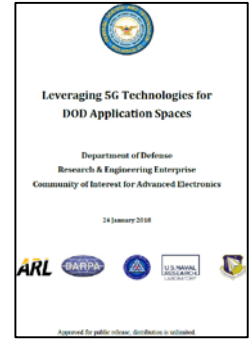


Major Changes/Accomplishments



A Few Outstanding Accomplishments

- **OSD Quantum Science and Engineering Program (QSEP): AFRL, ARL, NRL partnerships:**
 - Demo lab breadboard of a quantum dot strain sensor for gravimetry and accelerometry applications
 - Dual atom interferometer to measure rotation and acceleration for inertial navigation
 - Fabricated an entangled photon pair source
 - Completed broad progress on qubits based on vacancies in SiC and trapped ions
- **Prepared an AE Col Report: “Leveraging 5G Technologies for DoD Application Spaces”**
- Assessed and produced reports on global gallium nitride (GaN) COTS parts and GaN Qualification (AFRL/NRL APRICOT)
- **Demo of AFRL/ARL/NRL collaborative, cloud-based electronic design automation (EDA)**
- Developed and completed a successful industry IR&D review – new format
- **Produced advanced vacuum electronics for EW**
- **Developed a laser-based 2-photon absorption tool to emulate single-event-effects (SEE) and enable SEE mapping of ICs**
- **Successful transition of the Trusted Access Program Office (TAPO) program - NSA to DMEA**
- Produced preliminary images taken on Global Foundries 14nm devices using the DMEA developed X-Ray tomography tool
- Demo'ed high-operating temperature (up to 170K), mid-wave infrared focal plane array for higher mean time between failure



Node	ASIC	Digital Foundry			RF Foundry				
		SOI CMOS	CMOS	Low-Power CMOS	SiGe HBT	SiGe PA	RF SOI	RF CMOS	High-Voltage CMOS
32nm	Cu-12	1050K							
45nm	Cu-45	1250							
65nm			105P	100P				100F+	
90nm			95F	91P	5HP			95F	
130nm			55FG		50P	50P	WVL		85F
180nm					7W	70P	70P	70P	70P
250nm			95F		95F			70P	70P
350nm					5HP*	100P/50P	50P*	100P/50P*	50P*

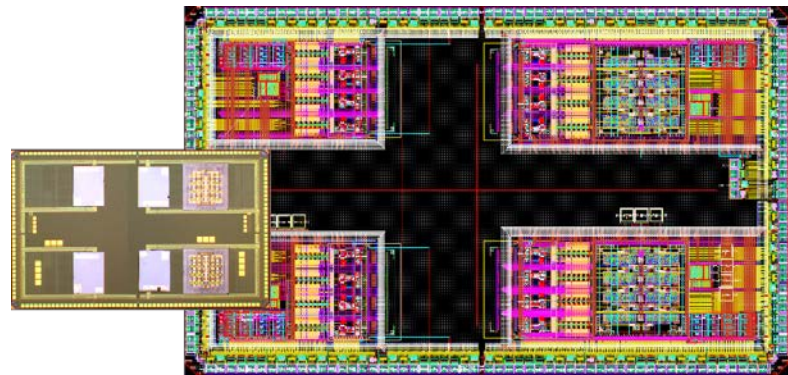
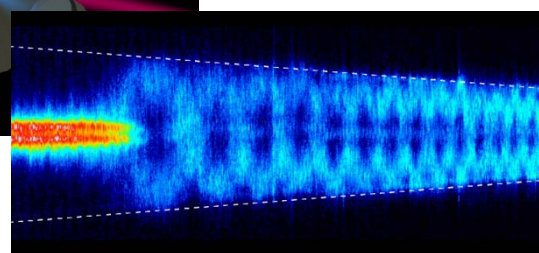
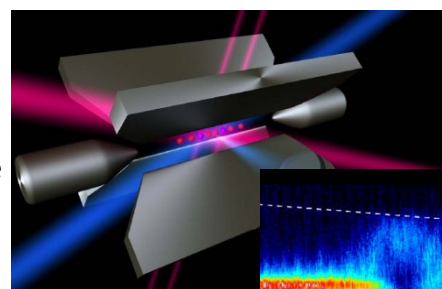


FY17-18 AE Col Emphasis



The Col bridges fundamental research and commercial investments to militarily-critical hardware capability gaps and new concepts:

- **Lead** in areas in which military-unique components create superior performance
- **Watch and leverage** international and commercial technology base
 - fast follower with investment focus on military-unique needs or opportunities
- **Understand** and mitigate globalization trends and technology availability
 - avoid technology surprise
- **Enable** full use of electromagnetic spectrum in highly contested environments and counter other's ability to do the same
 - deliver technology surprise and cost imposition
- **Assure** communications and on-board processing
 - basis for autonomy and swarms
- **Reduce** size, weight, power consumption and cost
 - basis for expendable and attritable
- **Enable** open system architectures
 - provide modularity for low cost upgrades
- **Increase** capability to operate in harsh environments, supply chain risk management, and sustainment (includes tamper-proofing technologies)
- **Establish** low-power electronics base
 - supports autonomous AI





Future Activity: FY18-19



- **Initiatives and best practices to accelerate R&D process**
 - AFRL/ARL/NRL collaborative, cloud-based electronic design automation (EDA)
 - Service lab participation in DARPA programs to facilitate rapid transfer of Service lab technology to warfighter via defense primes
 - Service labs leverage DARPA technology investments to focus on warfighter need
 - Increase cross-Col technology transfers
 - Army, Navy, AF and DMEA are working collaboratively with DARPA ERI
- **Cross-Col, Industry, Academia, Partnerships and/or Opportunities**
 - Apply Sinara universal controller for quantum experiments, 30+ lab setups in U.S. & Europe
 - Develop advanced vacuum electronic devices for EW application and transition of design tools to industry
 - DMEA leverage the National High Reliability Electronics Virtual Center's (HiREV) lessons learned at 90nm to buy down risk for reliability
 - DMEA Trust program evolve tiers of trust methodology (e.g. DARPA SPADE & OMG programs)
 - DMEA international partnership with SELEX Aerospace and University of Greenwich with emphasis on semiconductor device reliability focused on lead free microelectronics.
 - Multiple CRADAs with universities and commercial entities by all AE Col stakeholders



Future Direction



- **International Semiconductor Activities**
- **Synchronize efforts to address trust, supply chain integrated circuit challenges, and AE-Col priorities.**
- **Actions Underway for FY18:**
 - Transition QSEP to lasting service initiatives, lead Quantum S&T Strategic Road Mapping Study, and pursue recommended actions from the Study
 - Refine Roadmaps in updated taxonomy
 - Continue interactions with other Col's to help shape tech advances to best address warfighter needs
 - Determine Way Ahead for a Tri-Service unified approach to EDA
- **Extension**
 - Geographical
 - Technological
 - Business



Questions ?