



Integrity ★ Service ★ Excellence

High Reliability Electronics Virtual Center (HiREV) Overview and Status

**NEPP Electronic Technology
Workshop**

12 June 2013

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Outline



- **HiREV Mission & Strategy**
- **HiREV Team**
- **HiREV Status**
- **Technology Roadmap**
- **Reliability Science**
- **Summary**



HiREV Mission



Ensure timely delivery of independent, high-fidelity lifetime estimates for electronic device technologies and their corresponding underlying physics and chemistry of degradation and failure to enable their qualification for critical DoD and NSS applications.



HiREV Approach



- **Forecast emerging electronics technologies and opportunities; assess needs; advocate & perform prequalification studies**
- **Assess current qualification practices; identify and address shortfalls**
- **Create and maintain partnerships and capabilities with government, industry and academia through a virtual center concept**



HiREV Leadership Team



Systems Engineering



**Space Vehicles
Materials and Manufacturing
Sensors**



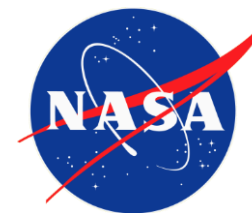
**System Planning, Engineering & Quality
Physical Sciences Laboratories
Electronics and Sensors Division**



Space & Missile Systems Center



Defense Microelectronics Activity



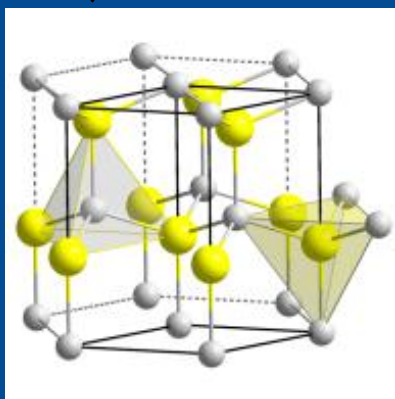
NASA



High Level Team Strategy



Understanding
built-up from
atomic scale



Materials
degradation
rates quantified



Assured mission
operation

Insure knowledge is preserved in updated lifetime models, standards, practices, processes & techniques for industry – encourage and sponsor industry participation



Refined ConOps



- **Technology Forecast**

Poll acquisition, prime and manufacturer communities

- **Reliability Science**

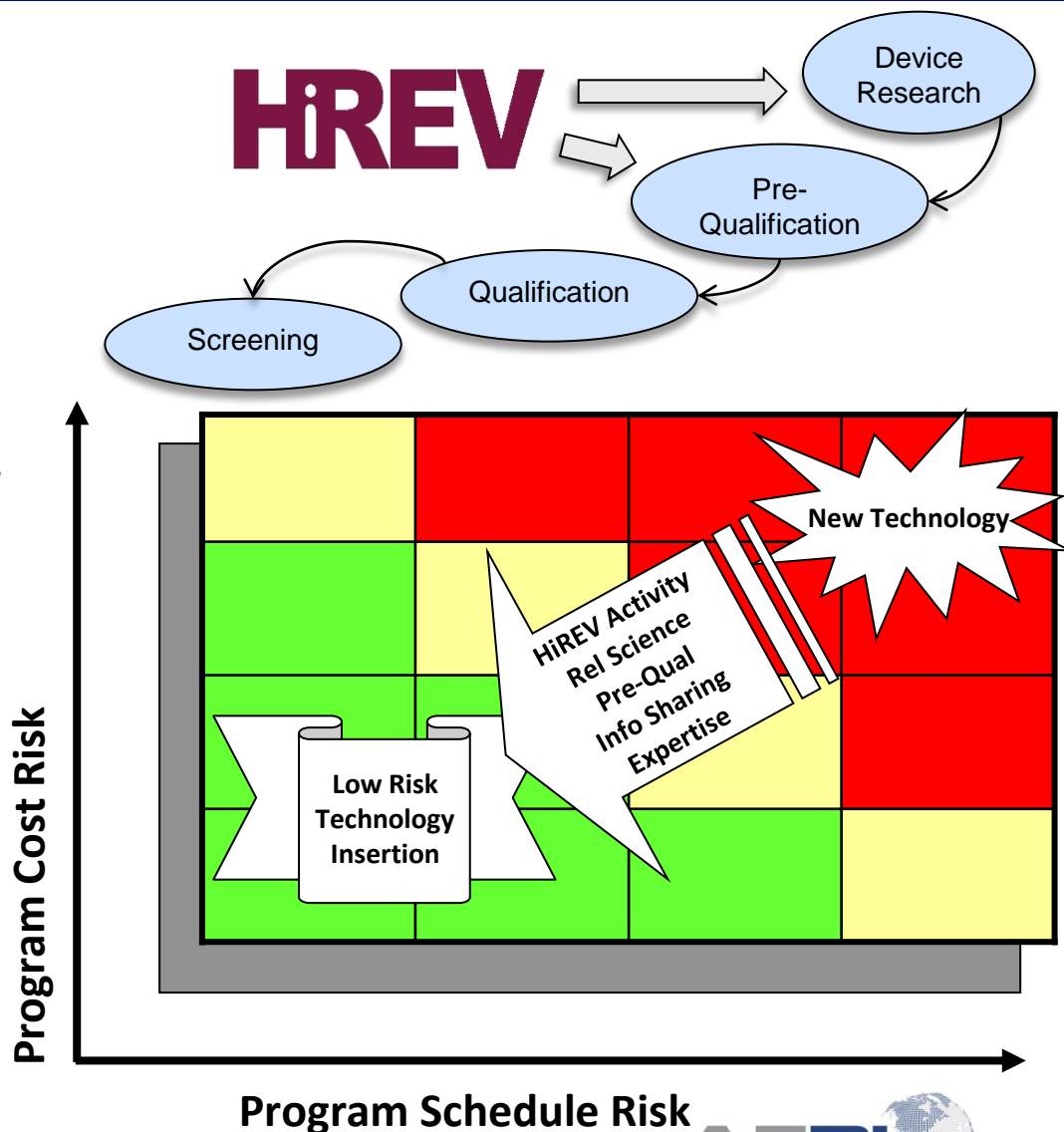
Physics and chemistry based models, tools and techniques

- **Prequalification**

Lit Reviews, test chip design and fab, testing, analysis, etc

- **Information Sharing**

Data, measurements, techniques, models, standards, guidelines, etc





Technology Forecasting



- **Goal - Anticipate the needs of the NSS acquisition community**
 - Prequalify before an insertion decision is finalized
 - Don't duplicate what is being done or already has been done
 - Identify knowledge gaps
- **Approach**
 - Develop a comprehensive electronics parts list for one relevant system in each domain of interest (Space/Air/Ground)
 - Develop a comprehensive list of electronic components by device technology effort/foundry, e.g. 9LP, 9SF, etc.
 - Gather available information from the community on the electronic device technologies including test results, projections, roadmaps and schedules
- **Status**
 - Initial Technology Roadmap developed
 - Aerospace TOR published; annual updates planned



Technology Roadmap



	Near Term 2012	Mid Term 2012-2014	Longer Term > 2015
Digital	<ul style="list-style-type: none">▪CMOS (150, 90, 65nm)▪Xilinx V-4 FPGA (90nm)▪HNY HX5000 (150nm)▪NG SONOS EEPROM	<ul style="list-style-type: none">▪CMOS (90, 65, 45nm)▪Xilinx V-5 FPGA (65nm)▪MRAM (HNY, Aeroflex)	<ul style="list-style-type: none">▪CMOS (32, 28, 22nm)▪Xilinx V-7 FPGA (28nm)▪BAE/Achronix (150nm)▪CNTs▪Freescale 45nm SOI
Analog/ Mixed Signal	<ul style="list-style-type: none">▪SERDES (HNY/BAE 150nm)	<ul style="list-style-type: none">▪CMOS (90, 65, 45nm)▪SiGe BiCMOS (130, 90nm)	<ul style="list-style-type: none">▪CMOS (32nm)▪InP HBT
Power		<ul style="list-style-type: none">▪GaN▪SiC	<ul style="list-style-type: none">▪GaN▪SiC

*Packaging for all new technologies



HiREV Reliability Science Focus



- **Beyond thermally accelerated life tests:**
 - Alternate stressors
 - Multiple stressors
 - Detailed statistical analysis beyond first order fits of the data
- **Materials Characterization at the nanoscale – tool development and application**
- **Improved models of device performance and degradation**
- **University Foundry Run: GaN HEMT devices and test structures specifically for university studies**



HiREV Reliability Science Performers



- **Air Force Institute of Technology:** Defect Studies & Radiation Effects
- **Arizona State University:** Electron Microscopy, Modeling
- **Georgia Institute of Technology:** Thermometry, Strain Behavior, Modeling
- **Iowa State University:** Reliability Statistics
- **Naval Postgraduate School:** GaN HEMT Modeling (Transient Behavior)
- **Purdue University:** Multi-Scale Device Modeling; Transient Device Thermography
- **SUNY Albany:** End of Life Modeling Analysis
- **Vanderbilt University:** Reliability and Radiation Effects

Reliability MURIs (Close Interaction):

- **AFOSR – University of Florida**
- **ONR – UC-Santa Barbara led (MIT, CMU, Ohio State U, NCSU, U. Michigan, Bristol and Vanderbilt)**



Prequalification



- **Goal - Determine whether or not a specific device technology is “qualifiable” for specific missions**
- **Approach**
 - **Develop quantitative analysis techniques to evaluate current practices – cost/benefits/risks**
 - **Currently evaluating JEP 118 (GaAs FETs and Mil Perf 38535 Appendix H)**
 - **Next on list is Mil Handbook 217**
 - **Develop and refine prequalification checklist – Initial checklist complete**
 - **Use checklist to survey existing knowledge**
 - **Develop cost and schedule to validate knowledge and gather missing knowledge**
 - **Perform prequalification studies on customer demand**
 - **Efforts are similar to Root Cause Investigations**
 - **Provide capability to perform multiple studies simultaneously**
 - **Support DARPA Integrity and Reliability of Integrated Circuits (IRIS)**



Summary



- **HiREV Center has expanded the core team and continues to make contributions**
- **Progress in multiple areas:**
 - Information Sharing – Lessons Learned
 - Prequalification approach refined
 - Preliminary Technology Forecast Completed
 - Multiple Reliability Science Advances
- **DARPA IRIS (Integrity and Reliability of Integrated CircuitS) program is a key activity**