



Developing the U.S. Defense Microelectronics Workforce

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Purdue SCALE Leadership



Peter Bermel, PhD.
SCALE Director
pbermel@purdue.edu

Kerrie Douglas, PhD.
SCALE Associate Director
kdouglas@purdue.edu

Tom McKinley, PhD.
SCALE Managing Director
tmckin@purdue.edu

Eric Holloway, PhD.
SCALE Internship Coordinator
ehollow@purdue.edu

Tamara Moore, PhD.
SCALE K-12 Director
tmore@purdue.edu

Jason Morphew, PhD.
Director of Undergraduate Curriculum
jmorph@purdue.edu

Alejandro Strachan, PhD.
nanoHUB Deputy Director
strachan@purdue.edu

Jenn Linvill, PhD.
Workforce Needs Director
jlinvill@purdue.edu

OUSD SCALE Leadership



Kara Perry, PhD.
SCALE Program Manager
kara.l.perry@us.navy.mil

Taylor Hubbard, Capt. USAF
MEST Program Manager
taylor.hubbard@us.af.mil

SCALE QUARTERLY

Scalable Asymmetric Lifecycle Engagement

Funded by the Office of the Under Secretary of Defense for Research and Engineering (OUSD R&E)
Trusted & Assured Microelectronics Program

SCALE provides students with opportunities in defense microelectronics. Students accepted into SCALE can:

- Gain access to open internship and career opportunities in preferred technical areas with employers
- Establish stronger connections with employers who are hiring in areas of strong national need
- Engage in research during the academic year with faculty
- Take special topics courses relevant to a preferred technical area

OUSD Funding for Radiation Hardened (RH) Projects

The Scalable Asymmetric Lifecycle Engagement (SCALE) microelectronics workforce development program will receive more than \$19 million in funding from the Office of the Under Secretary (OUSD) to strengthen efforts in key research areas and to add new academic partners.

The funding enhances efforts in radiation-hardened microelectronics and trusted artificial intelligence, while expanding student training, continuing education and dissemination. It includes \$3.7 million for Purdue University, \$5.6 million for Indiana University, \$2.7 million for the University of Florida, \$1.67 million for Vanderbilt University and Arizona State University, \$700,000 for nanoHUB, and significant amounts for 12 new and continuing partners.

Some of these subjects are the focus at several universities that have been added as SCALE partners: Morgan State University in Maryland, the University of Tulsa in Oklahoma, and the Microelectronics Security Training Center headquartered at the University of Florida.

The SCALE program is the nation's preeminent workforce development effort, funded by the Defense Department and managed by Naval Surface Warfare Center Crane. This public-private partnership boasts 19 universities and 48 partners within the defense industry and government.

SCALE has a mission to bolster next-generation workforce development to bring the United States back to prominence in global microelectronics re-



search and manufacturing. The demand for microelectronics increased by 26% in 2021. But while the United States consumes about half of the chips produced worldwide, only about 12% are manufactured domestically.

"Without action, multiple credible studies forecast major shortages in the microelectronics workforce on a national scale," said Dr. Peter Bermel, SCALE Director and Professor of Electrical & Computer Engineering at Purdue.

Fortunately, this new funding being recognized with OUSD Kickoff events in September 2023 will significantly expand the microelectronics workforce development programming.

-written by Evamarie Socha, Director, Communications and Public Relations, Applied Research & National Security Programs



Summer 2023- SCALE Radiation Hardened ME

During the summer of 2023, the Radiation Hardened Microelectronics (RH ME) Vertical held weekly Zoom meetings on Tuesdays at noon central for summer. These meetings were treated as a large research group meeting with a mix of talks given by students about their projects and papers that students had presented at conferences (NASA ETW and NSREC). Nineteen RHM SCALE students and 13 mentors from 6 of the RHM institutions attended the 2023 IEEE Nuclear and Space Radiation Effects Conference (NSREC), where multiple students led or were involved in several presentations.

Highlights of the summer activities include:

Vanderbilt University School of Engineering (VUSE) and SCALE supported 5 undergraduates (UGS) in the VUSE Summer Research Program and onboarded 2 new graduate students (GS) into SCALE for RHM research. A VU SCALE student won a best student paper award at NSREC, and another VU SCALE student won a best student abstract award for the upcoming RADECS conference in the fall. Nine

VU RHM SCALE undergrads graduated in May 2023.

SCALE supported 5 students working in the **Arizona State University** Radiation Damage Lab performing research on radiation effects testing at cryogenic temperatures and test instrumentation design.

Brigham Young University and SCALE supported 2 UGS and 2 GS in the summer IMMERSE program investigating approaches for testing complex System on Chip (SoC) and Field-programmable Gate Array (FPGA) devices for radiation effects.

SCALE supported 5 UGS at **St. Louis University** for the summer, working on Cubesat research and on single-event hardening algorithms for memories.

SCALE and **Georgia Tech** supported 1 UGS and 1 GS working on two-photon laser experiments in SiGe electronic devices and circuits.

SCALE supported 5 UGS at **St. Louis University** for the summer, working on Cubesat research and on single-event hardening algorithms for memories.

SCALE and the **University of Tennessee at Chattanooga** supported 4 GS and a UGS conducting radiation hardened microelectronics design research and radiation effects testing at cryogenic temperatures. One Master's student graduated and is pursuing a PhD in RHM. Two additional UGS graduated with BS degrees and will be attending graduate school in RHM.

New Mexico State University engaged multiple new faculty members and a new Master's student in SCALE activities

The Air Force Institute of Technology engaged a new PhD student in SCALE working of transient dose radiation testing.

University of Tennessee- Chattanooga supported 4 GS and a UGS conducting radiation hardened microelectronics design research and radiation effects testing at cryogenic temperatures. One Master's student graduated and is pursuing a PhD in RHM. Two additional UGS graduated with Bachelor's degrees and will be attending graduate school in RHM.

It was truly a busy summer for the RHM program!

-written by Dr. Michael Alles, ISDE Director

SCALE Partners

University Partners

Air Force Institute of Technology
 Arizona State University
 Brigham Young University
 University of Colorado-Boulder
 Georgia Institute of Technology
 Indiana University
 Indiana University– Purdue University Institute
 Morgan State University
 New Mexico State University
 Notre Dame University
 Ohio State University
 Purdue University (Lead)
 Saint Louis University
 SUNY-Binghamton
 Texas A&M University
 University of California-Berkeley
 University of Florida
 University of Tennessee-Chattanooga
 Vanderbilt University

Government Partners

Air Force Life Cycle Management Center (AFLCMC)
 Air Force Nuclear Weapons Command (AFNWC)
 Air Force Research Lab-Space Vehicles Directorate (AFRL/RV)
 Department of Energy National Nuclear Security Administration (DOE/NNSA)
 Missile Defense Agency (MDA)
 Naval Research Laboratories (NRL)
 NSWC-Crane
 National Aeronautics and Space Administration (NASA)
 Sandia National Laboratory
 Space Systems Command (SSC)
 U.S. Navy Strategic Systems Program (SSP)
 U.S. Air Force
 U.S. Air Force Materiel Command (AFMC)
 U.S. Army Combat Capabilities Development Command
 White Sands Missile Range (SVAD)

Industry Partners

Aerospace Corporation
 Ametum
 Analog Devices
 Applied Materials
 BAE Systems
 Blue Origin
 Boeing Corporation
 Calumet Electronics
 Cobham Advanced Electronic Solutions (CAES)
 Draper Labs
 General Dynamics
 GlobalFoundries
 IBM
 Innovative Scientific Solutions Inc. (ISSI)
 Integra Technologies
 Intel
 In-Q-Tel
 Johns Hopkins Applied Physics Laboratory
 KBR
 Keysight
 L3 Harris
 Mercury Systems
 Milanowski & Assoc.
 MIT Lincoln Labs
 Northrop Grumman
 Reliable Microsystems
 Renesas Electronics
 Science Systems and Applications Incorporated (SSA)
 Silicone Technologies
 SkyWater
 Taiwan Semiconductor Manufacturing Company (TSMC)
 Trusted Semiconductor Solutions

SCALE on nanoHUB

SCALE participants will find a slightly redesigned landing page at <https://nanoHUB.org/groups/SCALE>. Let us know what you think!

Students - some new resources can be found including resume and interview prep resources arranged by consortium partner universities (click on Internships in the top menu).

All - check out the SCALE templates and logos (see the bottom of the About page) and new content under Lecture Series, including the nanoHUB mini-workshop on content deployment from the PI Symposium this summer.

Faculty - we encourage all PIs to help grow and use the SCALE content hosted on nanoHUB. Ale Strachan (strachan@purdue.edu) and Tanya Faltens (tfaltens@purdue.edu) will reach out to all the verticals to discuss content deployment. PIs can now access a newly developed SCALE letterhead by navigating to the PI-only group through the tile at the bottom of the main SCALE group page. There, you can easily swap in your university logo at the bottom of the template. If you need help with this, send a note to contact@nanoHUB.org

Student Spotlight– Evelyn Marx

Meet SCALE standout (Engineering Influencer) Evelyn Marx, microelectronics research student at the Vanderbilt University (VU) Institute for Space and Defense Electronics (ISDE). During her junior and senior years of high school, she attended Ohio State University and studied software programming and engineering and was a member of the underwater robotics team. Following her brother to VU, she chose to study radiation effects and microelectronics, which ties together her interests in physics and quantum computing. In the initial week of her freshman year, Evelyn came across the [SMART Scholarship](#) program post on Instagram. Influenced by her father’s passion for education and her grandfather’s service as a captain in the Air Force Reserve, Evelyn found this as an opportunity to contribute to her country as an engineer in the defense-tech field. As a member of SCALE, she received a letter of recommendation from Dr. Mike Alles and was awarded the 2022 SMART Schol-

and Amy Joo will be happy to help.

Everyone - remember, you need to be logged in and have joined the SCALE or SCALE PI groups to access the content. To join, look for the “Request Membership” button in the upper right of the SCALE groups.

Sign up for [nanoHUB](#) today to access these resources.

—written by Dr. Lynn Zentner, Exec. Dir., Network for Computational Nanotechnology

Student Camps

This summer 36 teachers from the Crane and Lafayette, Indiana, areas attended one week of SCALE K-12 professional development held at Purdue University. SCALE K-12 is an engineering, design-based approach of professional development that helps teachers design curricular modules and activities for microelectronics (ME) within the Indiana State Academic Standards. Dr. Tamara Moore,

SCALE K-12 Director, led the team of faculty, staff, and graduate students as they guided high school and middle school teacher Fellows in the beginning design of a microelectronics curricular module and activity focused on ME contexts and/or concepts. During the school year, each Fellow will help design online professional development related to their curricular innovations. The second week of professional development for Fellows coincided with the Purdue INSPIRE camp, held July 17-21, for 8–10-year-old children. During the teacher professional development workshop, students had the opportunity to show off their electronic knowledge, their micro bit-controlled infinity mirror, and micro bat electric guitar. SCALE K-12 summer programming for children, led by Dr. Morgan Hynes, spanned three camps over 6 weeks with approximately 200 young students in attendance. During the week-long camp, students explored the world of microelectronics from their creation to their creative disposal. Students programmed micro bits to control lights for their puppet shows, disassembled electronics to repurpose parts and pieces as works of art, and learned how to program micro-controllers. —written by Rena Sterrett, Sr. Project Manager, SCALE K-12

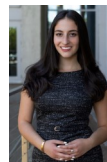


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arship, as well as an invitation to contribute to the SCALE curriculum project and allowing her to honor her father’s memory. Her work on the “Development of Certification Framework for a Microelectronics WFD Program” received the [Vanderbilt 2023 Best Undergraduate Research Award](#). After graduation in Spring 2024, Evelyn will be working at the Missile Defense Agency (MDA) in the field of Radiation Hardness, Quality, Safety, and Mission Assurance. This elected 2023 President of [Vanderbilt Women in Computing](#) and recipient of the 2023 Clinton Global Initiative stated, “My most important motivation is being able to prove myself in this field and be a role model for young women in engineering.”



—written by Mignon Evans, SCALE Administrative Assistant

2023 Event Calendar



Last Wednesday Monthly	SCALE Assessment Working Group Meeting
Fridays at 4 pm	SCALE Fall 2023 Weekly Research Working Group Meeting
5–9 November	RHET Conference in Allen, TX