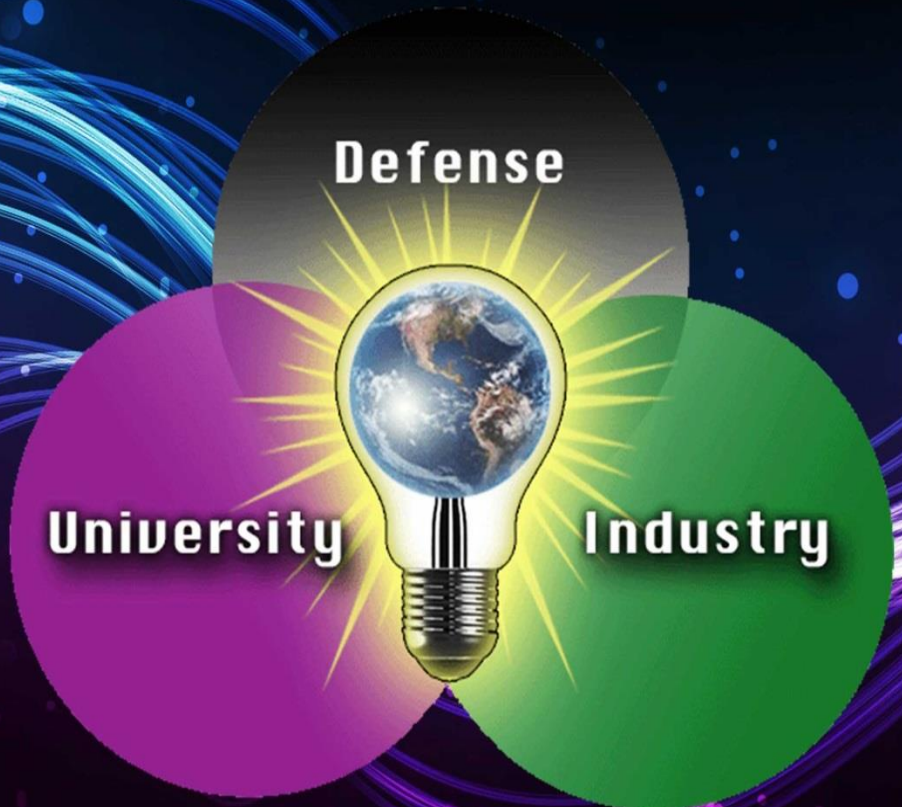


Innovation Crossover:

The Shape of Things to Come

SPARC Panel

Additive Manufacturing

Dr. Dan Berrigan, AFRL

Digital Thread for Enabling Patient Care

Hazim El-Mounayri, IUPUI

IUPUI | INITIATIVE FOR PRODUCT LIFE CYCLE INNOVATION
INDIANA UNIVERSITY–PURDUE UNIVERSITY Indianapolis

ESKENAZI HEALTH

scientivegroup
Digital Intelligence for a Data-Filled World

INDIANA UNIVERSITY
SCHOOL OF MEDICINE
Department of Emergency Medicine

Digital Thread for Enabling Patient Care

...a systems approach

Oct 12-13, 2016

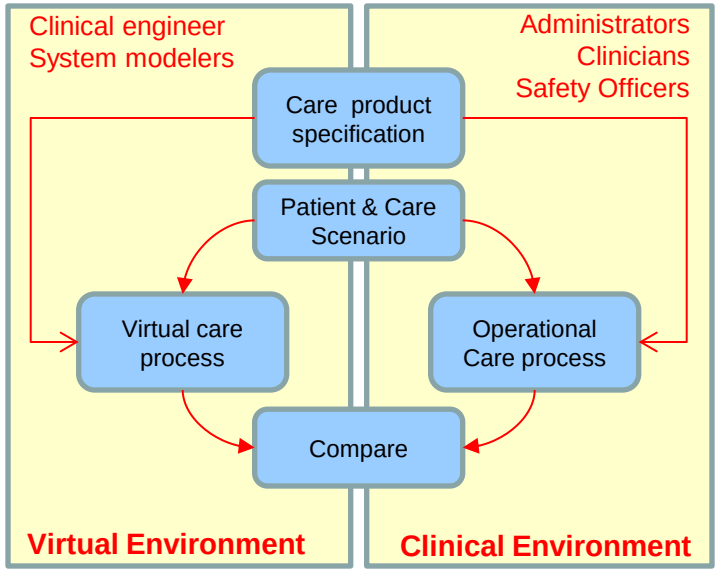
Prepared for:
NSWC Crane Innovation Crossover Challenges

Life Sciences
Second Challenge: Informatics technologies
Context: *Enable patient-centered health care through development of point-of-care, wireless, and personal health informatics technologies. Develop informatics technologies to provide information and feedback on people serving to allow instant access to their vital signs and the ability to direct medicine, hydration or other needs remotely, as well as provide remote diagnosis.*

scientivegroup
Digital Intelligence for a Data-Filled World

Virtual Assessment Environment

- **Issue**
  - Assess care products for efficiency, safety and effectiveness



Clinical Care Process Assessment

- **Approach**
  - Build *virtual* assessment environment
  - Implement care product models
  - Model, simulate & analyze comprehensively clinical scenarios
  - Real time access to clinical data
- **Business Value**
  - Virtual assessment highlights **bottlenecks** under various scenarios
  - M&S helps **identify faults** and care product **improvement**
  - Virtual assessment **supplement** real time clinical process **learning**
  - **Support decision making** through analysis and trade studies
  - **Reuse models** for next generation care products (cost & time saving)

Emerging health solutions are required to demonstrate quantification of effectiveness, mitigating risk, and ensuring safety for the patient as well as the providers.

Emergent Properties in Cybersecurity

Steve Meyers, Indiana University

SCHOOL OF INFORMATICS AND COMPUTING
INDIANA UNIVERSITY
Bloomington

Emergent Properties in Cybersecurity

Prof. Steven Myers

Dept. Of Computer Science

Indiana University

Commonalities?

RISK ASSESSMENT —

Record-breaking DDoS reportedly delivered by >145k hacked cameras

Once unthinkable, 1 terabit attacks may soon be the new normal.

DAN GOODIN - 9/28/2016, 8:50 PM

The Snow Debacle in Atlanta

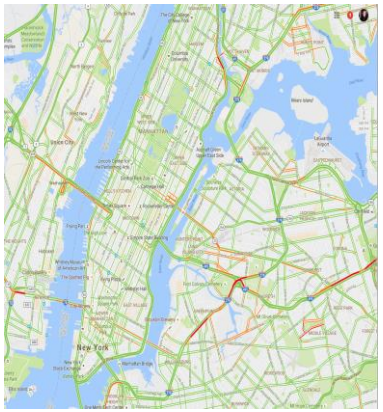
By Risen Tree
Wednesday Jan 29, 2014 · 8:16 PM EST

37 Comments (37 New) 23

Traffic maps of Atlanta on January 28, 2014.

Emergent Properties

SCHOOL OF INFORMATICS AND COMPUTING
INDIANA UNIVERSITY
Bloomington



1) Environment

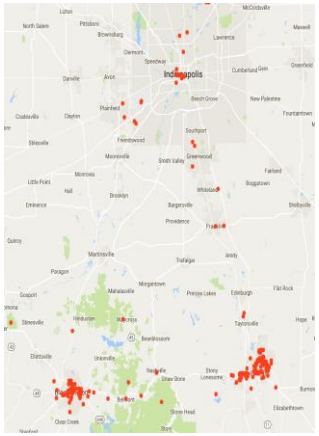
2) Large Numbers of Agents

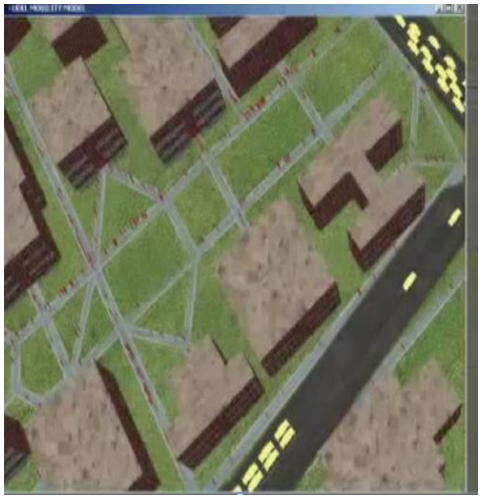
3) Agents Interact with each other and environment

4) Unplanned Interaction

5) New Emergent Behavior

Examples and Tools





Current

Near Future

Tools: Simulation

Enhanced Airman Performance

Dr. Erica Johnson, AFRL

STRONG: Signature TRacking for Optimized Nutrition and trainin G

Dr. Joshua Hagen, AFRL

Looking Beyond Visible

Dr. Ben Conley, NSWC Crane

Looking beyond Visible

Dr. Ben Conley, Electro-Optics Technology Division, NSWC-Crane

Image source: Jurassic Park

Left image source: http://www.unmannedsystemstechnology.com/2012/06/sofradir-boosts-performance-of-high-operating-temperature-mwir-infrared-detector/
Right image source: http://www.copybook.com/military/companies/icx-technologies/articles/ir-infrared-spectral-bands-and-performance

Image source: www.caranddriver.com

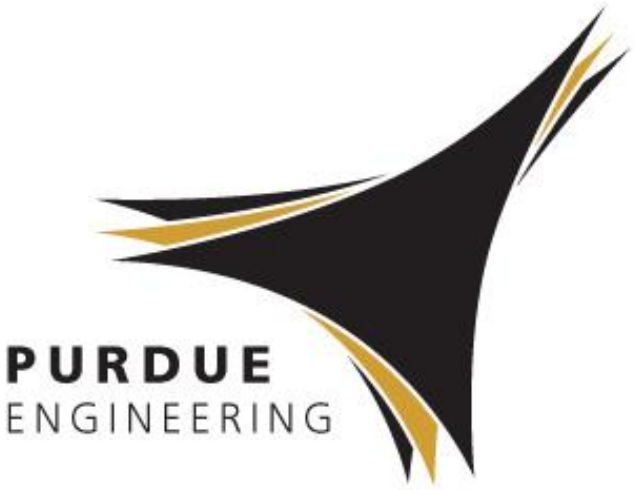
Beyond Visible: R&D at NSWC Crane

- **Uncooled imaging in infrared**
  - Move beyond semiconductor based detectors
  - Bulk materials have undesirable physical limitations
- **Fast frame rate – Closer to real time**
  - Improve digital processing algorithms or processor efficiency
  - Analog capture and display (photonic or electronic)
- **Solutions under progress at NSWC Crane**
  - Decouple thermal noise from infrared sensors by using metamaterials
  - Analog amplifiers can operate at higher frame rates with less power

Hypersonic Flight: A Critical National Need

Dr. Jonathan Poggie, Purdue University

Hypersonic Flight
A Critical National Need



Jonathan Poggie
School of Aeronautics and Astronautics

Guillermo Paniagua
School of Mechanical Engineering

Potential Breakthroughs

Payload Fraction

2.8%

6.3%

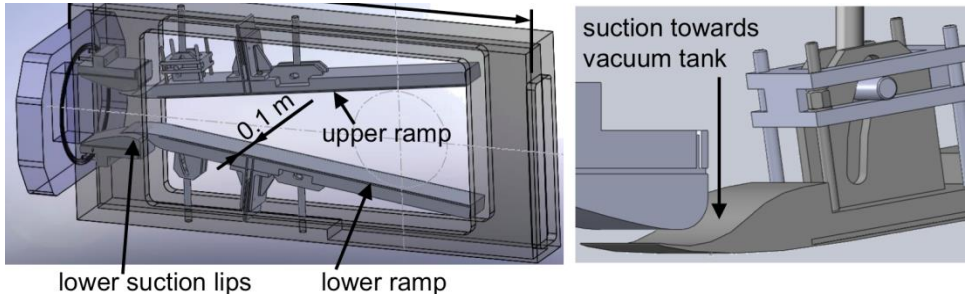
Air breathing stage: possible 5X or more improvement in payload fraction

Very Large Computers

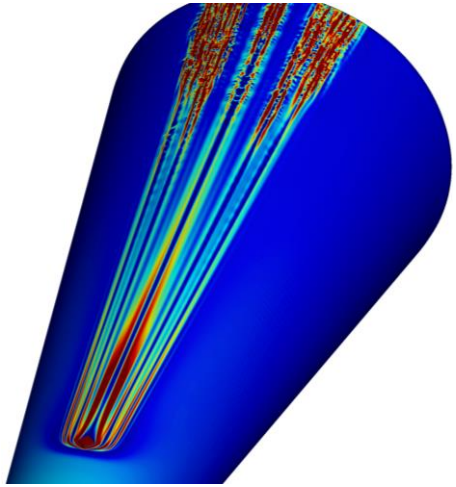
New Architectures

Extreme Heating

New Wind Tunnel Test Section
Zucrow Laboratory



Numerical Simulation

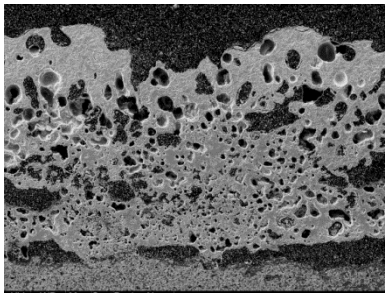


High-Temperature Materials

Ablated Samples

Top View

Side View



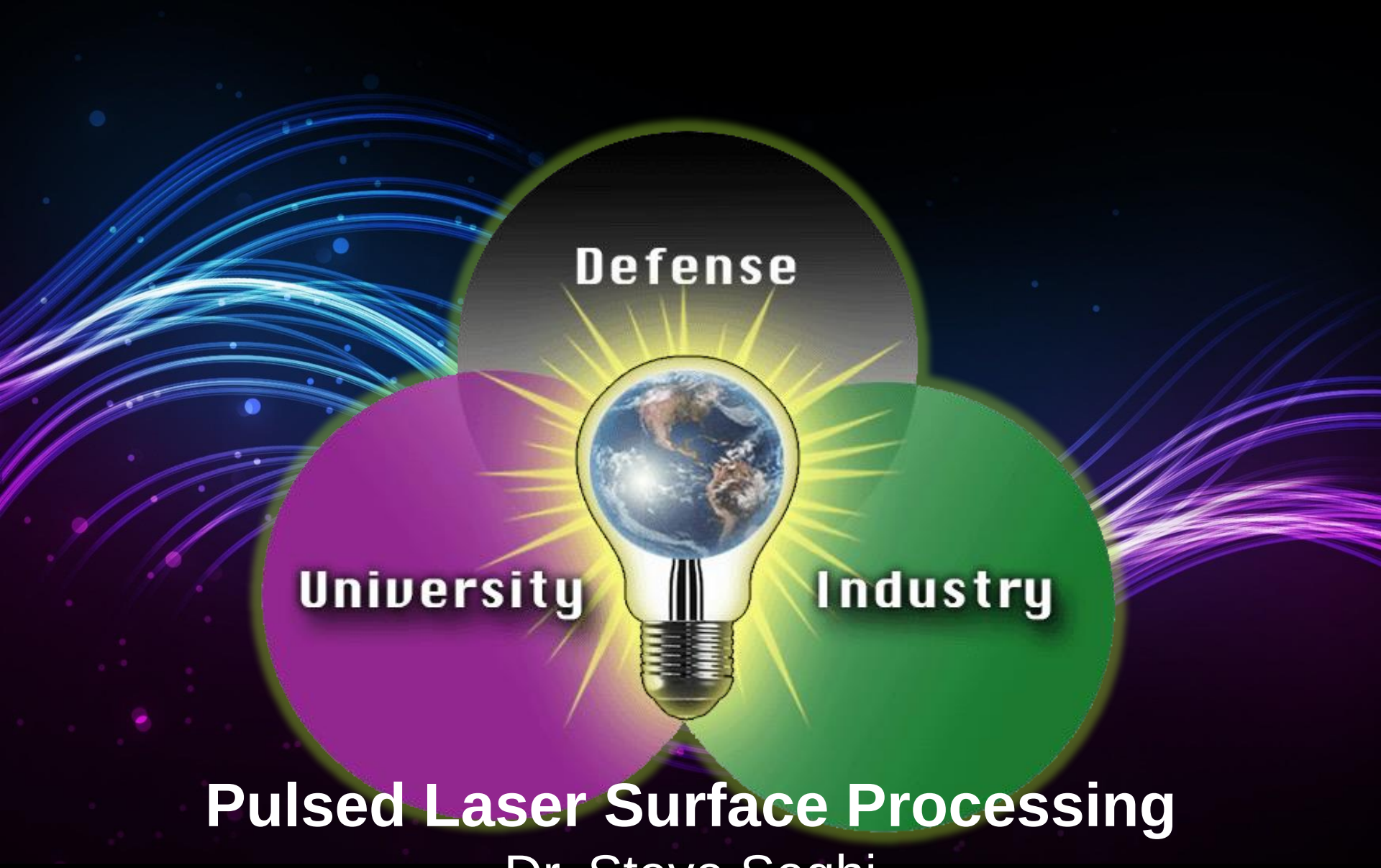
- Research to predict extreme heating rates in transitional and turbulent flow
- Exploit revolutionary computing power
- Bring high-temperature materials testing to the wind tunnel

Improvements in Non-Destructive Printed Circuit Board Reverse Engineering

Dr. Darren Crum

Machine Learning

Dr. Mark Linderman, AFRL



Pulsed Laser Surface Processing

Dr. Steve Seghi

Science Gateways to Support NSWC Crane Grand Challenges

Marlon Pierce, Indiana University

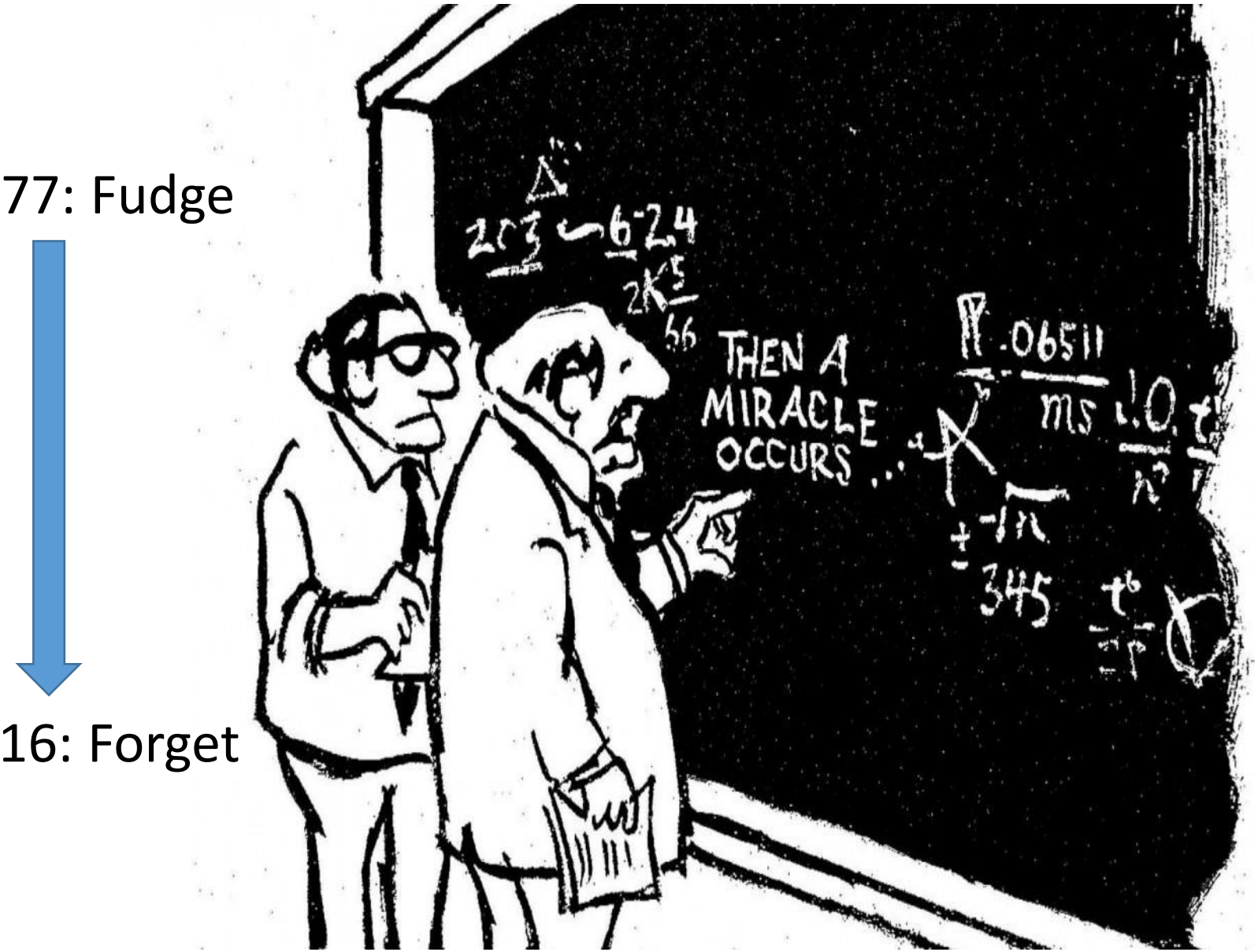
Science Gateways to Support NSWC Crane Grand Challenges

Marlon Pierce
Director, Science Gateways Research Center
Pervasive Technology Institute
Indiana University

APACHE AIRAVATA

SGRC

1977: Fudge



2016: Forget

APACHE AIRAVATA

SGRC

Science Gateways Are...

- Web interfaces and services to help scientists and engineers make better use of scientific applications and data on advanced computing resources.
  - Engineering: ANSYS, Abaqus, OpenFOAM, ...
  - Chemistry: Gaussian, NAMD, NWChem, LAMMPS, ...
  - Atmospheric Modeling: WRF, ...
- Science Gateways...
  - Increase productivity
  - Increase repeatability
  - Increase results sharing

APACHE AIRAVATA

Trusted Mircoelectronics

Dr. Matt Gadlage, NSWC Crane

Problem: Trusted & Reliable Electronics

tronics technology

varfighter a distinct advantage

- But def
  - **Trust**
  - **Relia**
    - Long life times
    - Extreme environme

Working Towards Solutions: SPECTRA

NAVSEA WARFARE CENTERS CRANE

NSWC Crane **SPECTRA** Research Group

Semiconductor Physics for Electronic Component Trust and Reliability Advancement

SPECTRA is a data-driven research group!

Current collaborations in the SPECTRA group:

NASA, Air Force, MDA, DARPA, DIA, JFAC, ARL, ONR, JPL, NRL, NRO, Arizona State, IU, Vanderbilt, Purdue, MIT, Xilinx, Sandia, RPI, Adesto, Achronix, Intel, and others.

Research from the past year:

1. A. H. Roach, M. J. Gadlage, A. R. Duncan, J. D. Ingalls, and M. J. Kay, "Interrupted PROGRAM and ERASE Operations for Characterizing Radiation Effects in Commercial NAND Flash Memories," *Nuclear Science, IEEE Transactions on*, vol. 62, no. 6, pp. 2390-2397, Dec. 2015.
2. M. J. Gadlage, A. H. Roach, A. R. Duncan, M. W. Savage, and M. J. Kay, "Electron-Induced Single-Event Upsets in 45-nm and 28-nm Bulk CMOS SRAM-Based FPGAs Operating at Nominal Voltage," *Nuclear Science, IEEE Transactions on*, vol. 62, no. 6, pp. 2717-2724, Dec. 2015.
3. A. R. Duncan, M. J. Gadlage, A. H. Roach and M. J. Kay, "Characterizing Radiation and **Stress-Induced Degradation** in an Embedded Split-Gate NOR Flash Memory," *Nuclear Science, IEEE Transactions on*, vol. 63, no. 2, pp. 1270-1283, April 2016.
4. M. J. Gadlage, A. H. Roach, A. Williams, J. D. Ingalls, M. J. Kay, A. R. Duncan, I. M[illegible]is, and E. Whitney, "Testing of the Most Radiation-Tolerant Multi-Gb NAND Flash Memory Known to Exist (and it's **Counterfeit**)," published in the 2016 GomacTECH Digest (presented at GOMAC March 2016).
5. A. R. Duncan, C. Szabo, M. J. Gadlage, A. Williams, K. LaBel, A. H. Roach, J. D. Ingalls, M. J. Kay, S. Guertin, and S. Silverman, "Single-Event Effects in Intel 14nm and 22nm Microprocessors," published in the 2016 GomacTECH Digest (presented at GOMAC March 2016).
6. A. H. Roach, M. J. Gadlage, J. D. Ingalls, A. Williams, A. R. Duncan, and M. J. Kay, "**Ensuring the Trust** of NAND Flash Memory: Going Beyond the Published Interface," published in the 2016 GomacTECH Digest (presented at GOMAC March 2016).
7. M. J. Gadlage, J. R. Ahlbin, P. [illegible]Mahoney, A. H. Roach, A. R. Duncan, M. R. Halstead, and M. J. Kay, "Alpha-Particle and Neutron-Induced Single-Event Transient Measurements in Subthreshold Circuits," *Reliability Physics Symposium, 2016 IEEE International*, pp. SE-1.1 - SE-1.1, April 2016.
8. M. J. Gadlage, A. H. Roach, J. M. Labello, M. R. Halstead, M. J. Kay, A. R. Duncan, J. D. Ingalls, and J. P. Rogers, "Electron Irradiation of NAND Flash Memories," accepted to the 2016 NSREC (Nuclear and Space Radiation Effects Conference) with subsequent publication planned for the IEEE Trans. on Nucl. Sci.
9. M. J. Kay, M. J. Gadlage, A. H. Roach, A. R. Duncan, J. D. Ingalls, and A. M. Williams, "Strategies for **Radiation Effects** in Bulk CMOS: Trends Observed with Xilinx FPGAs," presented at the 2016 HEART (Hardened Electronics and Radiation Technology) Conference and to be submitted to the JRERE Vol. 35.
10. A. R. Duncan, C. M. Szabo Jr., K. A. LaBel, M. J. Gadlage, D. P. Bossev, A. Williams, A. H. Roach, M. J. Kay, and J. D. Ingalls, "Single Event Effects in 14-nm Intel Microprocessors," accepted to the 2016 NSREC (Nuclear and Space Radiation Effects Conference) Data Workshop.
11. D. P. Bossev, A. R. Duncan, M. J. Gadlage, A. H. Roach, M. J. Kay, C. Szabo, T. J. Berger, D. A. York, A. Williams, K. LaBel, J. D. Ingalls, S. Guertin, and S. Silverman, "Radiation **Failures in Intel 14 nm Microprocessors**" presented at the 2016 Single Event Effects (SEE) Symposium/Military and Aerospace Programmable Logic Devices (MAPLD) Conference, La Jolla, CA, May 25-28, 2016.
12. D. P. Bossev, A. R. Duncan, M. J. Gadlage, A. H. Roach, M. J. Kay, C. Szabo, T. J. Berger, D. A. York, A. Williams, K. LaBel, and J. D. Ingalls, "Investigation of Radiation-Induced Response in Advanced Microprocessor" accepted to the 2016 International Symposium for Testing and Failure Analysis (ITSFA).

➢ **And 3 issued patents**