

Recent NEPP Program Accomplishments and Fiscal Year 2022 Plans

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To be presented by Peter Majewicz at the 2021 Radiation Hardened Electronics Technology (RHET) Conference 03NOV21

Agenda

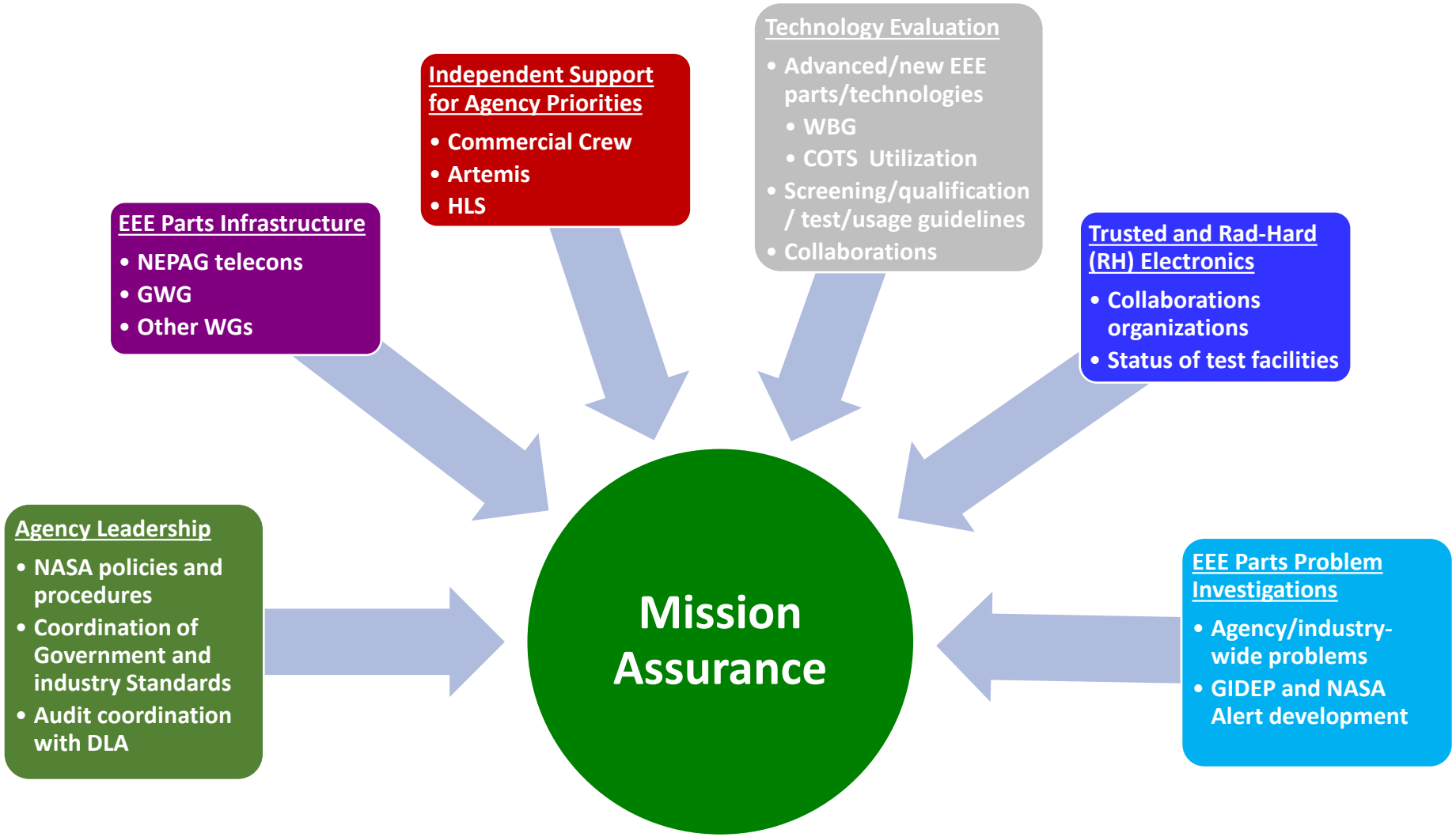
- NEPP Mission
- NEPP Charter
- FY21 Highlights
- FY22 Plans
- NASA NEWS

NEPP – Mission Statement

Provide NASA's leadership in the development and maintenance of guidance to support the reliable use of electrical, electronic, electromechanical, and electro-optical (EEEE) parts through characterization, lot acceptance, screening, and qualification testing in collaboration with academia, industry, international partners, and other government agencies.

NASA Electronic Parts Assurance Group (NEPAG) is a core portion of NEPP

NEPP Charter



Standards & Policy and Guideline Development



Participating in the Development of a NASA Engineering and Safety Center (NESC) Technical Assessment Report

- Title: *Recommendations on Use of Commercial-Off-The-Shelf (COTS) Electrical, Electronic, and Electromechanical (EEE) Parts for NASA Missions*
- Available for public download at NASA Technical Reports Server https://ntrs.nasa.gov/

- Currently in Phase II of Assessment including more government agencies (FAA, NAVSEA, MDA, etc.) and inviting manufacturers to discuss COTS manufacturing
  - Objectives are to define term *Industry Leading Parts Manufacturers* and to understand methods that manufacturers use to measure quality, assurance, and reliability.
  - Goal is for report to be made available to public once through the release process.

Standards & Policy and Guideline Development



NASA/NESC recently completed development of:

- Title: *Avionics Radiation Hardness Assurance (RHA) Best Practices*
- Available for public download at NASA Technical Reports Server https://ntrs.nasa.gov/
- Covers total ionizing dose, total non-ionizing dose, and single-event effects
- Will form the basis of a new NASA technical standard for RHA.
  - Development of the new standard will begin in FY2022

Standards & Policy and Guideline Development

Development of the *NASA EEEE Parts Selection, Testing and Derating Standard (NASA-STD-8739.11)*

- Update:
  - Last 2 Sections complete (Wire & Cable and Thermistors)
  - Removed the PCB Section
  - Final Review (local) and entering the NASA document approval process (Agency)

- Changes from EEE-INST-002:
  - 4 Screening and Lot Acceptance Testing Levels
  - Plan is 27 Device Specific Sections
  - Status: In Approval Process

- Capacitor
- Connectors
- Crystal
- Crystal Oscillator
- Detector
- Fiber Optics
- Filter
- Fuse
- Heaters
- Laser Devices
- Magnetics
- Microcircuit Hybrid
- Microcircuit Monolithic
- Microcircuit PEM
- Microcircuit RF / Microwave Devices
- Microcircuit Hybrid PEM
- Motors
- Optoelctronics
- ~~Printed Circuit Boards~~
- Relays
- Resistors
- Semiconductor Devices - Discrete
- Semiconductor Devices - PES
- Switch
- Thermister RTD
- Wire and Cable

Red: New sections

FY21 Highlights

FY2021 NEPP Work

Work Force Development

- Radiation Test Workshop focused on heavy ion single-event effects (SEE).
  - Goal is to produce a hands-on tutorial at the NASA Space Radiation Laboratory
  - Collaboration with Missile Defense Agency (MDA)
  - Extension of the SEE Testing Bootcamp at Texas A&M University (NASA/JPL)

MILSPEC Support

- Proposing new 19500 RHA Appendix listing radiation testing requirements for devices that will meet the user's mission and radiation environments requirements.
- Proposed ELDRS requirements for MIL-STD-750 Test Method 1019 (Total dose testing) to compliment the new LDR (low dose rate) requirement in 1019.
- Proposing new test method TM 1082 for Schottky diode Single Event Burnout (SEB).
- Supporting standardization of RHA power MOSFET 19500 slash-sheet format.

Select FY2021 NEPP Work

Using High-Energy Heavy Ions for Single Event Effect Assurance of EEE Parts

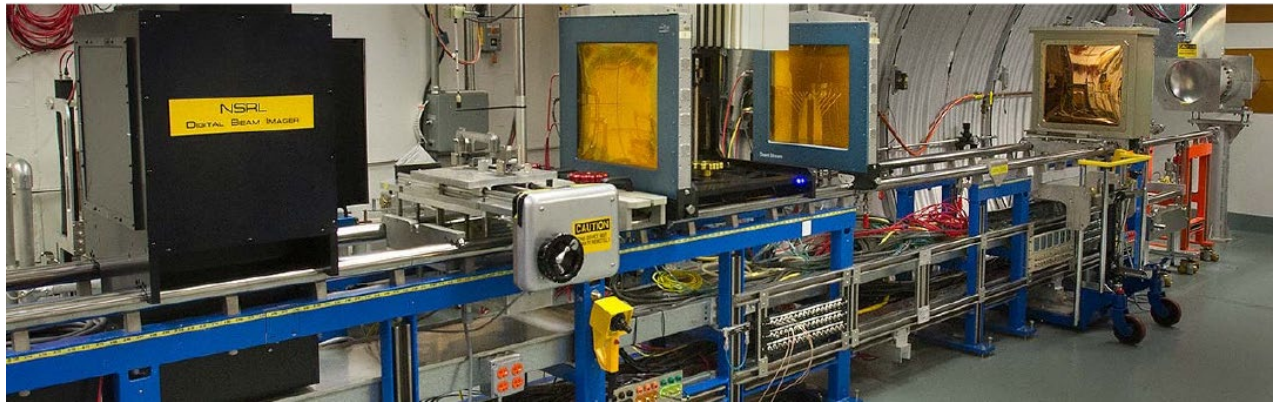
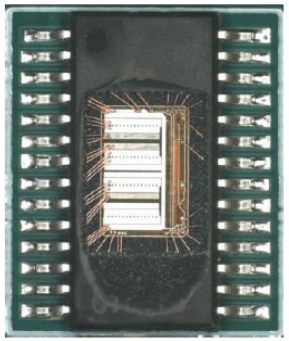


Photo credit: NASA

Environmental & Destructive SEE Testing of COTS Power Electronics



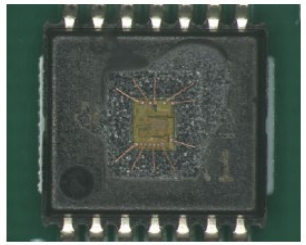


Photo credit: NASA

MILSPEC Support

- Plastic Encapsulation
  - 19500
  - 35835
- Heterogeneous Integration
  - 38534/ATM
- Testing Specs

Pulsed Laser Radiation Assurance Recommendation Document

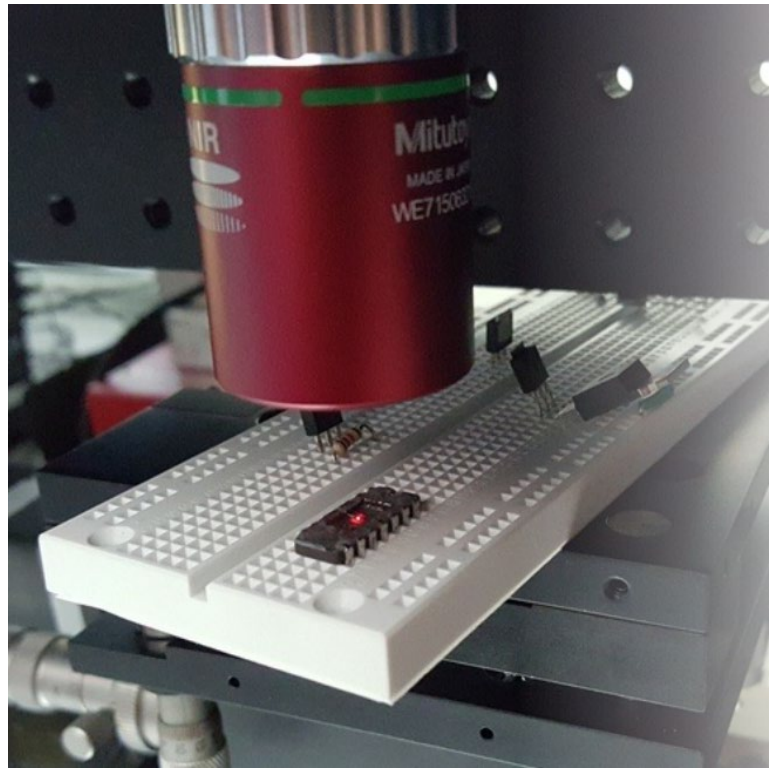


Photo credit: NASA

2021 NEPP Electronic Technology Workshop

Rad Policy / WFD / Rad Test Fac's

Avionics Radiation Hardness Assurance Guidelines Jonny Pellish (GSFC)

Radiation Effects Boot Camp and MS degree program at TAMU (Henry Clark, TAMU)

Heavy Ion Single-Event Effects (SEE) Test Facility Status and General Implications for Space System Evolution - Jonny Pellish (GSFC)

Is High Energy Heavy Ion Testing the Future for Single-Event Effects (SEE) in Devices and Systems? Ken LaBel (GSFC/SSAI)

WBG

WBG Power Device Radiation Reliability
Jean-Marie Lauenstein (GSFC)

Proton Recoils in GaN & Upcoming RF GaN work
Jason Osheroff (GSFC)

Hardening of Silicon Carbide for Lunar Application
Art Witulski (VU)

PHOTONICS

Photonics for Space Flight Instruments
Hali Jakeman (GSFC)

NEPP Space Qualification Efforts for Photonic Integrated Circuits (PICs)
Amanda Bozovich (JPL)

Radiation Effects in Integrated Silicon Photonic Systems
George N. Tzintzarov and John D. Cressler (GA Tech)

Processors / FPGAs / Memories

Scaled CMOS Radiation Reliability Update
Megan Casey (GSFC)

NEPP Processor Enclave - Partnerships and GitLab across the Agency
Ed Wyrwas (GSFC/SSAI) - Steve Guertin (JPL)

NVM Radiation Relibility Update - Ted Wilcox (GSFC)

A Monte Carlo-Based Analysis of Radiation Effects Mechanisms in 3D NAND Memories - Matthew Breeding (VU)

NEPP 2021 FPGA Radiation Effects Update: Microchip PolarFire (Single Event Effects) and Lattice Crosslink (Single Event Effects and Total Ionizing Dose) - Melanie Berg (GSFC/SSAI)

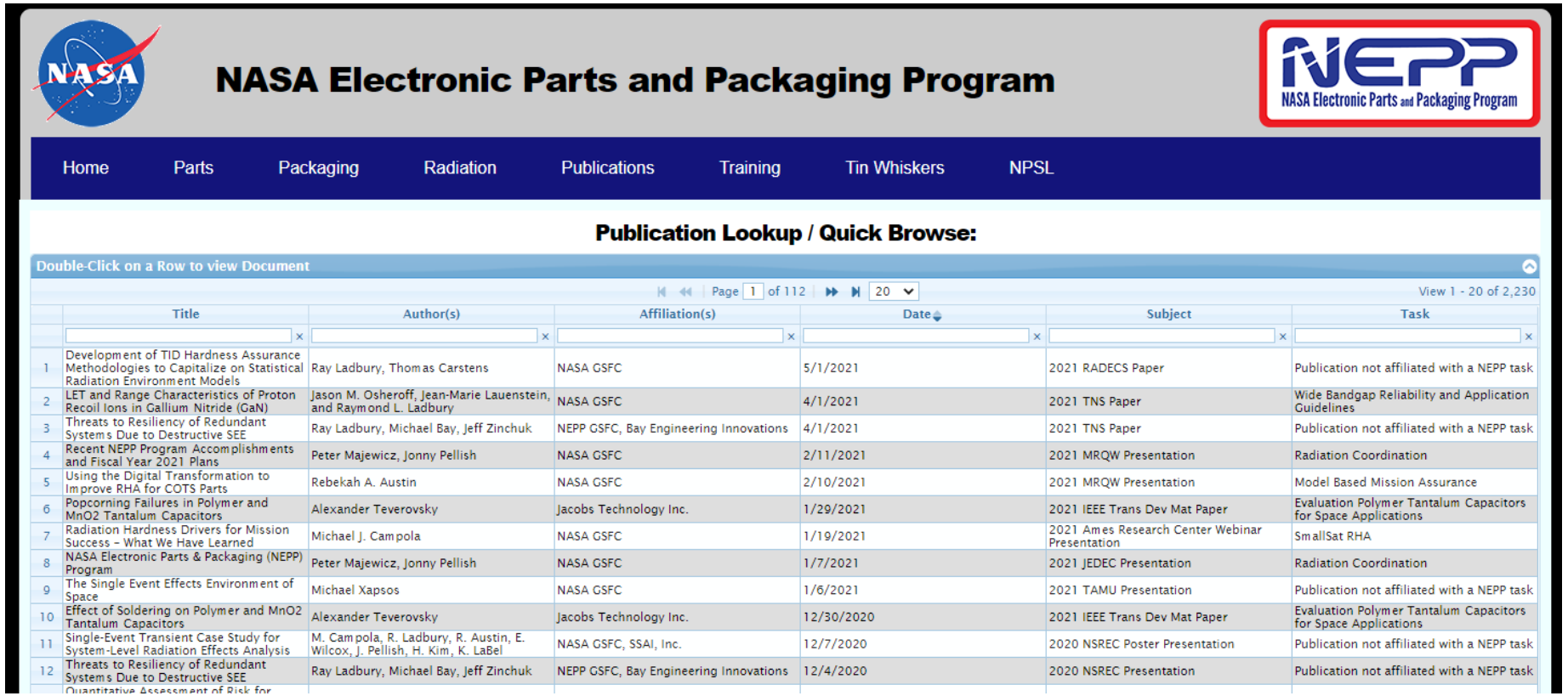
Extending A Probabilistic Method for Total Ionizing Dose Failure to Multi-Component Systems - Chloe Champagne (VU)

Radiation assessment of commercial computing platforms for highly shielded radiation environments - Mahmud Reaz (VU)

Evaluating SEE Rate Prediction Methods for Complex Devices - Brian Sierawski (VU)

All NETW presentations for 2021 and past years are at https://nepp.nasa.gov/

NEPP Website



NASA Electronic Parts and Packaging Program

Home | Parts | Packaging | Radiation | Publications | Training | Tin Whiskers | NPSL

Publication Lookup / Quick Browse:

Double-Click on a Row to view Document

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	Title	Author(s)	Affiliation(s)	Date	Subject	Task
1	Development of TID Hardness Assurance Methodologies to Capitalize on Statistical Radiation Environment Models	Ray Ladbury, Thomas Carstens	NASA GSFC	5/1/2021	2021 RADECS Paper	Publication not affiliated with a NEPP task
2	LET and Range Characteristics of Proton Recoil Ions in Gallium Nitride (GaN)	Jason M. Osheroff, Jean-Marie Lauenstein, and Raymond L. Ladbury	NASA GSFC	4/1/2021	2021 TNS Paper	Wide Bandgap Reliability and Application Guidelines
3	Threats to Resiliency of Redundant Systems Due to Destructive SEE	Ray Ladbury, Michael Bay, Jeff Zinchuk	NEPP GSFC, Bay Engineering Innovations	4/1/2021	2021 TNS Paper	Publication not affiliated with a NEPP task
4	Recent NEPP Program Accomplishments and Fiscal Year 2021 Plans	Peter Majewicz, Jonny Pellish	NASA GSFC	2/11/2021	2021 MRQW Presentation	Radiation Coordination
5	Using the Digital Transformation to Improve RHA for COTS Parts	Rebekah A. Austin	NASA GSFC	2/10/2021	2021 MRQW Presentation	Model Based Mission Assurance
6	Popcorning Failures in Polymer and MnO2 Tantalum Capacitors	Alexander Teverovsky	Jacobs Technology Inc.	1/29/2021	2021 IEEE Trans Dev Mat Paper	Evaluation Polymer Tantalum Capacitors for Space Applications
7	Radiation Hardness Drivers for Mission Success – What We Have Learned	Michael J. Campola	NASA GSFC	1/19/2021	2021 Ames Research Center Webinar Presentation	SmallSat RHA
8	NASA Electronic Parts & Packaging (NEPP) Program	Peter Majewicz, Jonny Pellish	NASA GSFC	1/7/2021	2021 JEDEC Presentation	Radiation Coordination
9	The Single Event Effects Environment of Space	Michael Xapsos	NASA GSFC	1/6/2021	2021 TAMU Presentation	Publication not affiliated with a NEPP task
10	Effect of Soldering on Polymer and MnO2 Tantalum Capacitors	Alexander Teverovsky	Jacobs Technology Inc.	12/30/2020	2021 IEEE Trans Dev Mat Paper	Evaluation Polymer Tantalum Capacitors for Space Applications
11	Single-Event Transient Case Study for System-Level Radiation Effects Analysis	M. Campola, R. Ladbury, R. Austin, E. Wilcox, J. Pellish, H. Kim, K. LaBel	NASA GSFC, SSAI, Inc.	12/7/2020	2020 NSREC Poster Presentation	Publication not affiliated with a NEPP task
12	Threats to Resiliency of Redundant Systems Due to Destructive SEE	Ray Ladbury, Michael Bay, Jeff Zinchuk	NEPP GSFC, Bay Engineering Innovations	12/4/2020	2020 NSREC Presentation	Publication not affiliated with a NEPP task

http://nepp.nasa.gov/

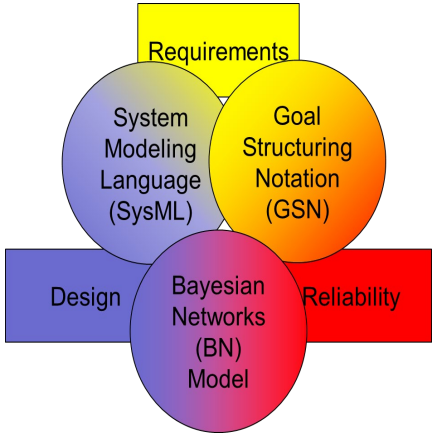
SAVE THE DATE!

13th Annual NEPP Electronics Technology Workshop (ETW)

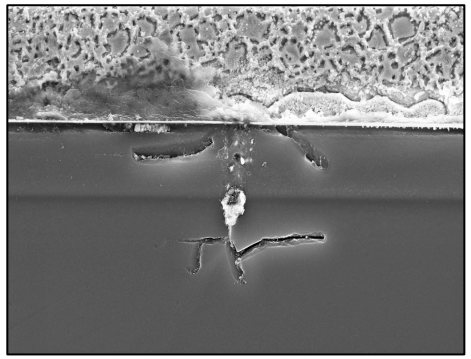
Scheduled dates:

June 13-16, 2022

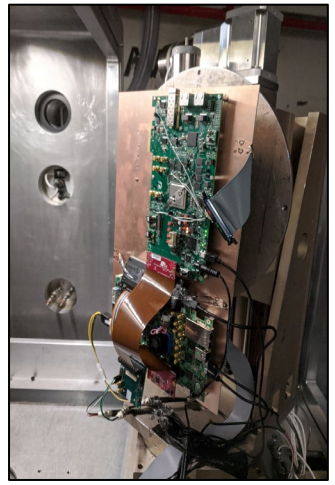
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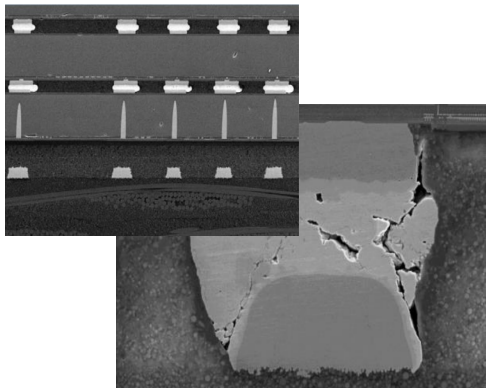
Emerging Assurance Methods
Image Credit: Vanderbilt University



Advanced Technology Reliability
Image Credit: NASA



Radiation Testing & Analysis
Image Credit: NASA



Advanced Microelectronics Packaging
Image Credit: NASA

FY22 Plans

Processor Enclave Testing
- NVIDIA
- AMD
- Intel

Radiation Effects Testing
- Scaled CMOS
- NVM (3D NAND Flash)

Ultrascale, Ultrascale+ & Versal FPGA Radiation Effects Testing

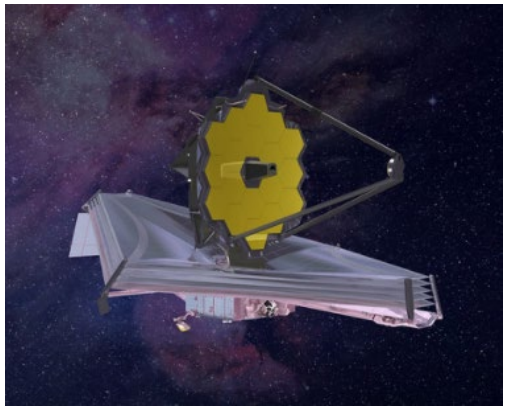
WBG & SOA Si Power Devices

Integrated Photonics for Next Generation Optical Communication Links

- Pulsed Laser Radiation Assurance Recommendation Document
- Using High-Energy Heavy Ions for Single Event Effect
- TID Assurance from Europa Clipper Mission

NASA News

James Webb Space Telescope



Drawing credit: NASA



Photo credit: NASA

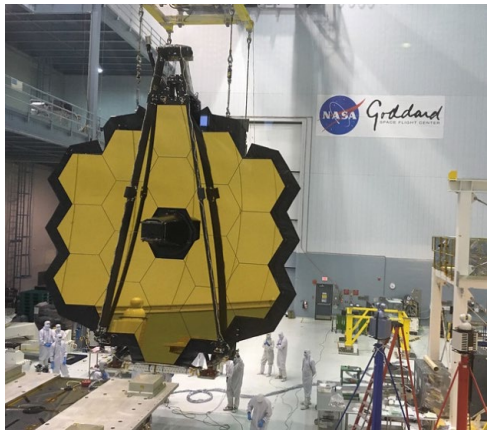


Photo credit: NASA



Drawing credit: NASA

- Launch: Scheduled for approx. 30-day voyage to L2
- Launch date: 18 Dec 21

Deployment animation: https://www.youtube.com/playlist?list=PL691BF261E32A4420 video: 5 min, actual: 13 days

Artemis I

Launch date: Feb 2022



Drawing credit: NASA

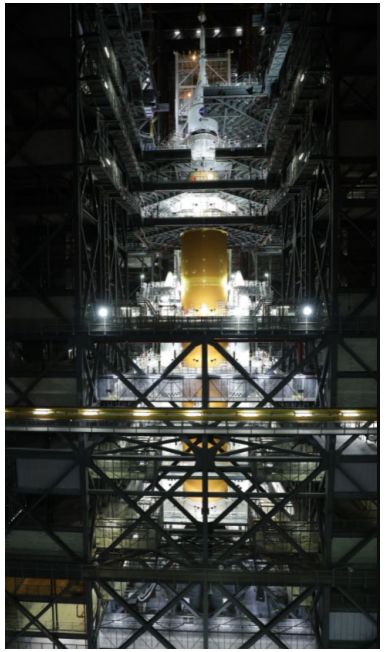


Photo credit: NASA



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The End

Acronyms

Abbreviation	Definition		Abbreviation	Definition
AF	Air Force		NASA	National Aeronautics and Space Administration
BGA	Ball Grid Array		NEPAG	NASA Electronic Parts Assurance Group
BN	Bayesian Network		NEPP	NASA Electronic Parts and Packaging (Program)
BoK	Body of Knowledge		NESC	NASA Engineering and Safety Center
CMOS	Complementary Metal Oxide Semiconductor		NODIS	NASA Online Directives Information System
COTS	Commercial Off the Shelf		NPR	NASA Procedural Requirement
CPU	Central Processing Unit		NRO	National Reconnaissance Office
DDR	Double Data Rate		NSREC	Nuclear and Space Radiation Effects Conference
DLA	Defense Logistics Agency		OCE	Office of the Chief Engineer
DMEA	Defense Microelectronics Activity		OGA	Other Government Agency
DoD	Department of Defense		PIC	Photonic Integrated Circuit
DoE	Department of Energy		POC	Point of Contact
EEE	Electrical, Electronic, and Electromechanical		PoF	Physics of Failure
ETW	Electronics Technology Workshop		RF	Radio Frequency
FPGA	Field Programmable Gate Array		RH	Radiation Hardened
GaN	Gallium Nitride		RHA	Radiation Hardness Assurance
GIDEP	Government Industry Data Exchange Program		SAPP	Space Asset Protection Program
GPU	Graphics Processing Unit		SDRAM	Synchronous Dynamic Random Access Memory
GRC	Glenn Research Center		SEE	Single-Event Effects
GSFC	Goddard Space Flight Center		SiC	Silicon Carbide
GSN	Goal Structuring Notation		SMA	Safety and Mission Assurance
HQ	Headquarters		SMC	Space and Missile Systems Center
IC	Integrated Circuit		SOA	Safe Operating Area
IEEE	Institute of Electrical and Electronics Engineers		SoC	System on a Chip
JPL	Jet Propulsion Laboratory		SRAM	Static Random Access Memory
JSC	Johnson Space Center		SSAI	Science Systems and Applications, Inc.
LaRC	Langley Research Center		STMD	Space Technology Mission Directorate
LGA	Land Grid Array		STT	Spin Transfer Torque
MAPLD	Military and Aerospace Programmable Logic Devices (Workshop)		SysML	System Modeling Language
MBMA	Model-Based Mission Assurance		TID	Total Ionizing Dose
MRAM	Magnetic Random Access Memory		TSV	Thru-Silicon Via
MSFC	Marshall Space Flight Center			