

Facilities and Capabilities
**NASA Center for Radiation Engineering and Science for Space
Exploration and affiliated laboratories.**
Prairie View A&M University

PVAMU has partnered with NASA for over twenty years to develop capabilities in space radiation science and engineering and educate underrepresented minorities through research.

PVAMU CRESSE has extensive facilities and experience with the following:

- Radiation dosimetry measurements for flight and ground-based radiation experiments.
- Designing radiation experiments for all types of aerospace environments.
- Radiation shielding and degradation evaluation of aerospace materials.
- Radiation effects on electronics for aerospace applications.
- Fabrication of nano-materials for radiation detection.
- Research and development to increase the TRL level of materials and devices.
- Integrating STEM students into hands-on research in all the above.
- Creating STEM student pipelines.
- Project and contract management expertise.

General Facilities:

The core laboratory facilities for the PVAMU CRESSE group are approximately 6,500 sq. ft. These facilities house the following instrumentation:

1. Hewlett-Packard 4145 and 4156 parametric analyzers for electrical measurements.
2. Keithly probe station with Keithly System 8100 parametric analyzer for electrical measurements. (Other device characterization facilities listed below.)
3. Four point probe system for conductivity and resistivity measurements.
4. A variety of techniques are available for materials characterization:
 - a. -Digital Instruments Atomic Force Microscopy (AFM)
 - b. -Digital Instruments Scanning Tunneling Microscopy (STM)
5. Radiation testing and research using gamma rays, protons, neutrons and heavy-ion ground-based radiation sources to simulate the space environment (see below).
6. Radiation dosimetry instrumentation: tissue equivalent proportional counters (TEPC) along with silicon, carbon, lead, and bone equivalent proportional counters (see below).
7. Flight dosimetry instrumentation and data analysis (see below).
8. Fume hood for materials processing.
9. Vacuum oven for device annealing and materials processing.
10. Mechanical testing capabilities include tension, compression, short-beam shear, and flexural tests under ambient, elevated (up to 600°C) and LN2 temperatures, indentation testing, crack growth testing, fatigue testing and other ASTM composite material tests.
11. A small sample 3-D printer, Model: ZPrinter 450, 3DP TM.

Radiation Testing Facilities:

On campus (In the Department of Electrical and Computer Engineering):

PVAMU has a 160 kV x-ray source with a tungsten target that provided a broad spectrum x-ray spectrum with energy peaks at about 55 keV and 66 keV. The maximum ionizing dose rate is about 5.9 krad/min, making space relevant doses of 100 krad possible in a reasonable time.

Off campus (Facilities needed for particle irradiation at energies commensurate with space applications):

PVAMU has extensive experience at several radiation facilities relevant to aerospace radiation environments:

- NASA Space Radiation Laboratory (NSRL) at Brookhaven National Laboratory: This facility provides protons and heavy ions (including iron) at energies that simulate component of the galactic cosmic ray (GCR) spectrum. The GCR are found in all space radiation environments and are particularly important for exploration missions. The PVAMU group has been performing experiments at the facility since 2003.
- Loma Linda University Proton Facility: This facility, primarily used for radiation therapy, provides protons with energies commensurate with solar protons and some parts of the GCR proton spectrum. These protons are relevant to LEO and trapped radiation belt missions. The PVAMU group has been performing experiments at this facility since 2004.
- Los Alamos Neutron Science Center: This facility provides high energy neutrons with an energy spectrum that mimics the secondary neutron spectrum in Earth upper atmosphere and is relevant to research and commercial aircraft. The PVAMU group has been performing experiments at this facility since 1998.
- Lawrence Livermore National Laboratory: This lab has National Institute of Standards and Technology (NIST) certified radiation sources used for detector and dosimeter calibrations. The PVAMU group recently (August 2014) used this facility as part of the RAD-X project with NASA Langley.

Radiation Dosimetry and Spectroscopy:

These capabilities allow for radiation dosimetry measurements in a variety of radiation fields, both for flight and ground-based accelerator experiments.

- Tissue equivalent proportional counter (TEPC) for ground based radiation experiments. This can be used for radiation shielding evaluation.
- Portable microdosimetry spectrometer system with also includes silicon, and carbon equivalent detection heads.
- “Hawk” TEPC flight dosimeter for aircraft radiation measurements.
- Ashland radiosensitive film dosimetry system (new).
- He-3 neutron detector

Electronics Design and Modeling:

Software available in the Department of Electrical and Computer Engineering for circuit design and software:

- Multisim for circuit design, schematics and simulation.

- Labview for circuit schematics, layout and simulation.
- Matlab Simulink for circuit simulation and model-based design, test and verification of embedded systems.
- Xilinx FPGA based design software. Xilinx manufactures radiation tolerant FPGAs used in conjunction with this software.

PVAMU has established an FPGA laboratory and it is an integral part of undergraduate and graduate STEM courses.

Recent (past 3 years) contractors and collaborators:

- Department of Homeland Security to develop new STEM courses in nuclear security and nuclear forensics.
- Air Force Research Labs SBIR partnership with PrivaTran LLC to study radiation effects on novel nanotechnology.
- Nanoracks to integrate passive radiation detectors into a International Space Station Payload (Work performed through the ISS office at JSC as part of the University Research -1 consortium. Collaborated with the Space Radiation Analysis Group at JSC.)
- Space Environment Technologies LLC SBIR with NASA Langley to develop aerospace flight dosimetry instrumentation.

Worked with The Boeing Company, Clear Lake to evaluate radiation shielding materials and radiation tolerance of electronic parts (2008 – 2009). Contact: Dr. Paul Boeder.

Other current collaborators:

- Texas Southern University and the ISS University Research-1 collaboration.
- Texas A&M University
- Oklahoma State University
- University of Surrey, UK

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