



# Marshall Space Flight Center Solar and Ultraviolet Radiation Testing



Engineering Solutions for Space Science and Exploration

## MSFC's Solar and Ultraviolet Radiation Testing

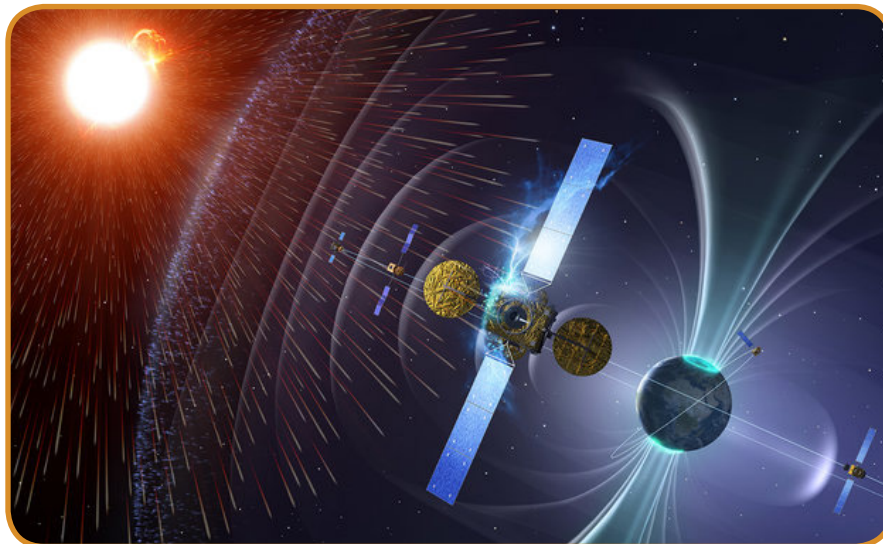
The Sun emits charged particles (protons and electrons) and high-energy light [near and vacuum ultraviolet (NUV and VUV) radiation] that can damage spacecraft. Charged particles and UV radiation can cause both hardening (cross linking) and weakening (chain scission) of polymers that comprise elements of the vehicle itself or its payloads, blemish optics and windows, destroy electronics, and pose serious threat to astronauts.

The impacts of the solar environment vary greatly, depending on distance from the Sun. Spacecraft scattered across the solar system, whether in Earth orbit or journeying to outer planets or approaching the Sun itself, experience dramatically varying conditions. Whatever the destination, spacecraft and crews must have reliable protection from the threats the Sun poses, with the best materials

available for spacecraft and heat shields, instrumentation, and spacesuits.

MSFC's radiation and UV test capabilities provide a comprehensive energy range of protons, electrons, and

high-energy photons to simulate the many variations in space environments. Radiation sources can be used in concert or individually to create specific testing environments. Researchers can expose materials or systems to a combination of particles and particle energies sequentially or simultaneously to investi-



gate possible synergistic effects. Fluences can be tailored to simulate a specific exposure at a defined environment or to allow comparison testing of different materials at the same exposure. Outgassing and contamination testing with and without UV allow for photo-deposition studies.

# Solar and UV Radiation Testing Capabilities

## Combined Environmental Effects Facility

- Low-energy electron source: 1–100 keV
- High-energy electron source: 250 eV–2.5 MeV
- Proton source: 40–700 keV
- VUV radiation: 115–165 nm
- 109.7-cm sq (17-in. sq) exposure area



## Solar Wind Test Facility

- Low-energy electron source: 1–100 keV
- Low-energy proton source: 1–20 keV
- VUV radiation: 115–165 nm
- NUV radiation: 230–500 nm
- Solar simulator
- 77.4-cm sq (12-in. sq) exposure area

## Strontium-90 Source

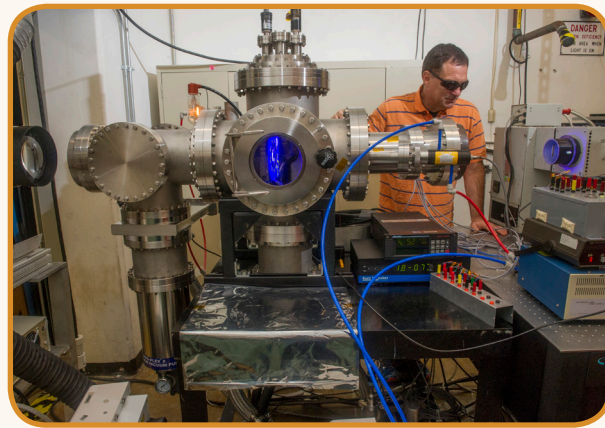
- L2 deep-space spectrum simulation
- Beta spectrum emitter: >2 MeV
- Activity: 100 mCi

## X-25 Solar Simulators (3)

- 2.5-kW xenon arc lamps
- Typical lamp spectrum: 250–2,200 nm
- Adjustable intensity:
  - > 1–3 equivalent Suns (ES) at AM0 over 0.33-m (13-in.) beam spot
  - > 10 ES at AM0 over 0.1-m (4-in.) beam spot

## Enhanced NUV Radiation Systems (2)

- 1-kW mercury-xenon lamps accentuate UV output
- Lamp output spectrum: 230–500 nm
- Intensity: 2–5 ES over 0.2-m (8-in.) beam spot



## Combined NUV/VUV Radiation System

- VUV source with enhanced NUV source
- VUV source spectrum: 115–165 nm
- NUV source spectrum: 230–500 nm
- VUV intensity: 5 ES (15-cm (6-in.) beam spot)
- NUV intensity: 3 ES (15-cm (6-in.) beam spot)

## High Intensity Solar Environment Test System

- Solar wind environment:
  - > Low-energy electron source: 0.05–100 keV
  - > Proton source: 0.2–10 keV
  - > NUV intensity: 5 ES (15-cm (6-in.) beam spot)
  - > VUV intensity: 3 ES (15-cm (6-in.) beam spot)
- Solar intensity: 10 ES over 0.6-m (2-ft) beam spot
- High-temperature materials/components testing (space and terrestrial applications): >1,000 °C (>1,832 °F)
- Calibration and qualification of science instruments to a relevant space environment (Technology Readiness Level-6)

## Additional Electron and Proton Sources

- Low-energy electrons: 1–100 keV
- Low-energy protons: 1–30 keV

For more information, please visit [www.nasa.gov/centers/marshall/about/business.html](http://www.nasa.gov/centers/marshall/about/business.html)

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