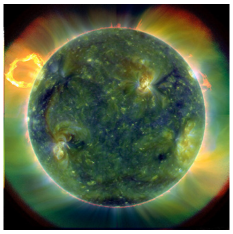
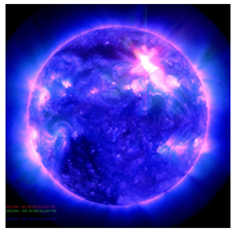
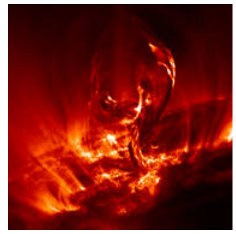
National Aeronautics and Space Administration

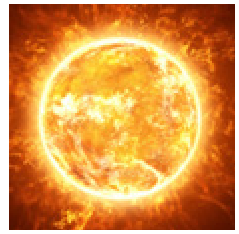
Marshall Space Flight Center

Solar and Ultraviolet Radiation Testing





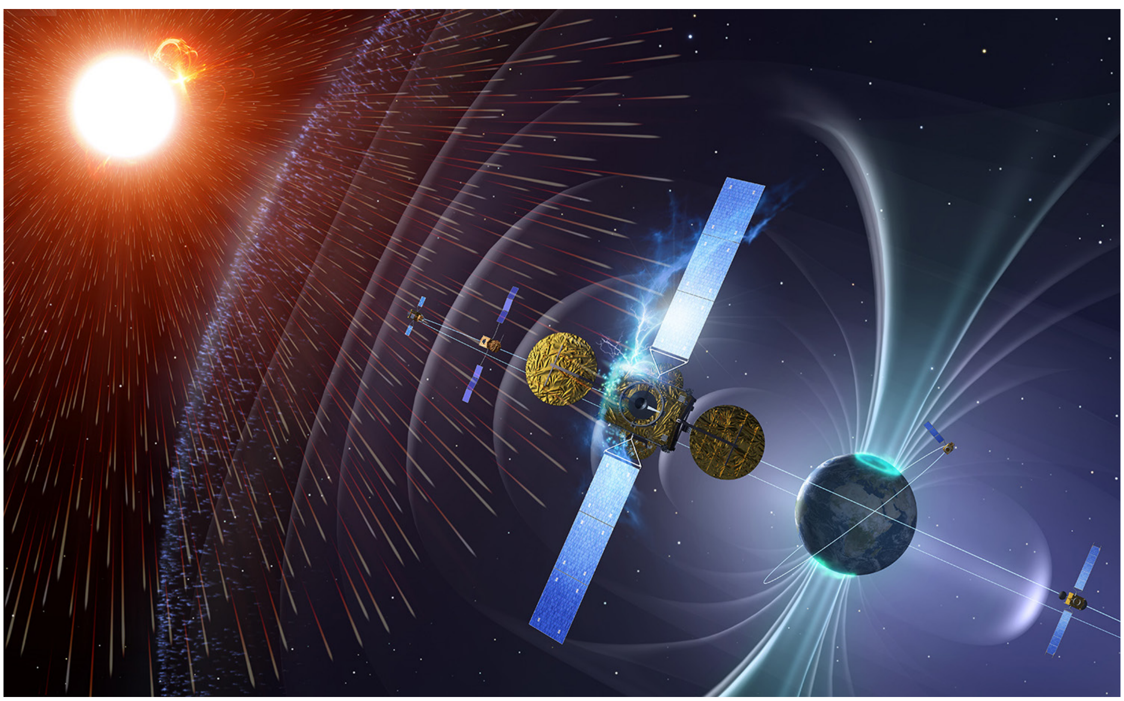




The Sun emits charged particles (protons and electrons) and high-energy light [near and vacuum ultraviolet (NUV and VUV) radiation] that can damage spacecraft. Charged particles and UV radiation can cause both hardening (cross linking) and weakening (chain scission) of polymers that comprise elements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

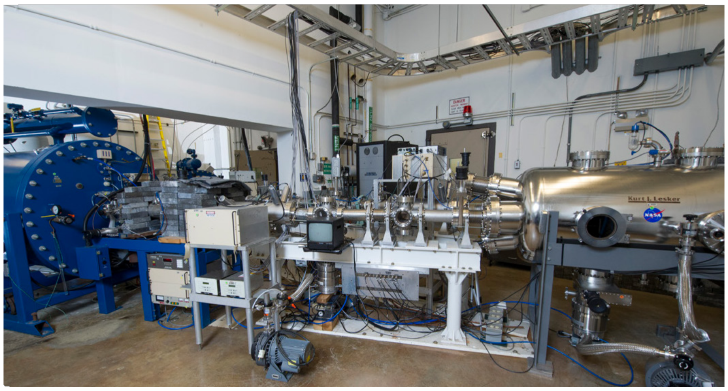
The impacts of the solar environment vary greatly, depending on distance from the Sun. Spacecraft scattered across the solar system, whether in Earth orbit or journeying to outer planets or approaching the Sun itself, experience dramatically varying conditions. Whatever the destination, spacecraft and 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 investigate 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.



Combined Environmental Effects Facility (CEEF)

- 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^2 (17-in^2) exposure area
- Temperature range 25°C to –175



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^2) exposure area

X-25 Solar Simulators (3)

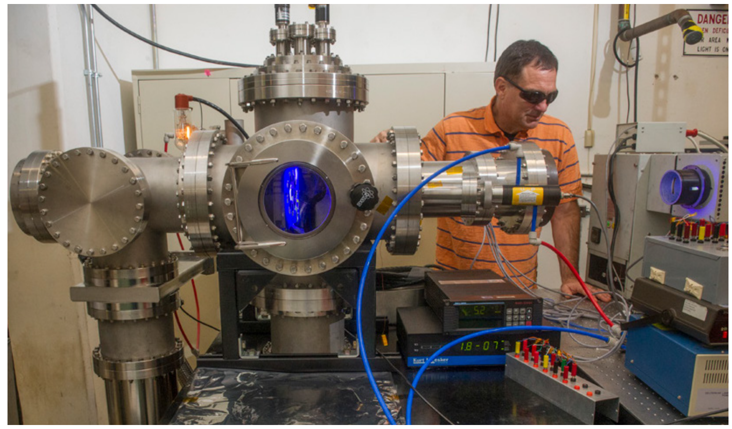
- 2.5-kW xenon arc lamps
- Typical lamp spectrum: 250–2,200 nm
- Adjustable intensity:
- 1–3 Equivalent Suns (ES) at AM0 over 0.33-m (13-in.) beam spot
- 10 ES at AM0 over 0.1-m (4-in.) beam spot

Additional Electron and Proton Sources

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

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: 0.05–20 keV
  - Ion source: 0.2–10 keV (Ar, N2, H2, and Xe ions)
  - NUV intensity: 5 ES (15-cm (6-in.) beam spot)
  - VUV intensity: 3 ES (15-cm (6-in.) beam spot)
  - Solar intensity: 4 ES over 0.6-m (2-ft) beam spot
  - High-temperature materials/components testing (space and terrestrial applications): greater than 1,000 °C (greater than 1,832 °F)
- Calibration and qualification of science instruments to a relevant space environment (Technology Readiness Level-6)
- Cold Shroud with liquid nitrogen (LN^2) Capability. Samples can be at high temperature or low down to –175 °C

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MSFC-02-2025-G-657270 (18)

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