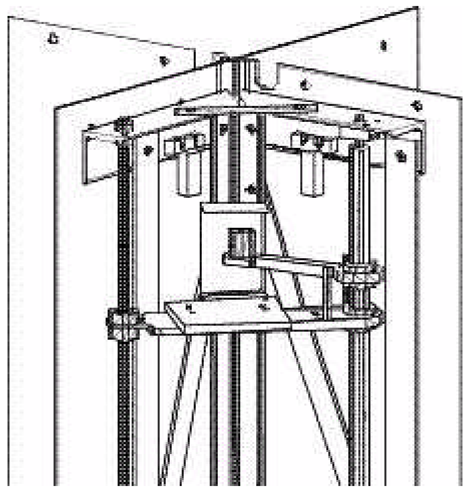
Steady-State Vacuum Ultraviolet Exposure Facility With Automated Lamp Calibration and Sample Positioning Fabricated

The Next Generation Space Telescope (NGST) will be placed in an orbit that will subject it to constant solar radiation during its planned 10-year mission. A sunshield will be necessary to passively cool the telescope, protecting it from the Sun’s energy and assuring proper operating temperatures for the telescope’s instruments. This sunshield will be composed of metalized polymer multilayer insulation with an outer polymer membrane (12 to 25 μm in thickness) that will be metalized on the back to assure maximum reflectance of sunlight. The sunshield must maintain mechanical integrity and optical properties for the full 10 years. This durability requirement is most challenging for the outermost, constantly solar-facing polymer membrane of the sunshield. One of the potential threats to the membrane material’s durability is from vacuum ultraviolet (VUV) radiation in wavelengths below 200 nm. Such radiation can be absorbed in the bulk of these thin polymer membrane materials and degrade the polymer’s optical and mechanical properties. So that a suitable membrane material can be selected that demonstrates durability to solar VUV radiation, ground-based testing of candidate materials must be conducted to simulate the total 10-year VUV exposure expected during the Next Generation Space Telescope mission.

The Steady State Vacuum Ultraviolet exposure facility was designed and fabricated at the NASA Glenn Research Center at Lewis Field to provide unattended 24-hr exposure of candidate materials to VUV radiation of 3 to 5 times the Sun’s intensity in the wavelength range of 115 to 200 nm. The facility’s chamber, which maintains a pressure of approximately 5×10^{-6} torr, is divided into three individual exposure cells, each with a separate VUV source and sample-positioning mechanism. The three test cells are separated by a water-cooled copper shield plate assembly to minimize thermal effects from adjacent test cells. Part of the interior sample positioning mechanism of one test cell is shown in the illustration.

Of primary concern in VUV exposure is the maintenance of constant measured radiation intensity so that the sample’s total exposure can be determined in equivalent Sun hours. This is complicated by the fact that a VUV lamp’s intensity degrades over time, necessitating a decrease in the distance between the test samples and the lamp. The facility overcomes this challenge by periodically measuring the lamp’s intensity with a cesium-iodide phototube and adjusting the sample distance as required to maintain constant exposure intensity. Sample positioning and periodic phototube location under the lamp are both achieved by a single lead-screw assembly. The lamps can be isolated from the main vacuum chamber for cleaning or replacement so that samples are not exposed to the atmosphere during a test.



Interior sample positioning mechanism.

This facility is operated by Glenn's Electro-Physics Branch and controlled through a computer program that automates lamp calibration, sample positioning, and test duration. The program also monitors system conditions for quality and safety and will abort a test if necessary.

For more information, visit the Electro-Physics Branch--
http://www.grc.nasa.gov/WWW/epbranch/ephome.htm.

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Programs/Projects: NGST, VUV exposure, LEO simulation