



SIMULATION CHAMBER

Charged Particle Physics, PLASMA PHYSICS BRANCH

FACILITIES

- Space Plasma Simulation Facility
- Scaled Ionospheric Plasma Conditions
- Scaled Magnetospheric Plasma Conditions
- Radiation Belt Particle Dynamics Simulation
- Plasma Source and Diagnostic Development
- Spacecraft Hardware Preflight Testing
- High-Altitude Atmospheric Testing
- Electrostatic Plasma Probes
- Particle Energy Analyzers
- Laser-Induced Fluorescence
- Plasma Impedance Tomography
- High-Energy Electron Production
- Controlled Magnetic Field Topography



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ABOUT

Opened in 1990, the NRL Space Physics Simulation Chamber Laboratory has been developed to conduct investigations into the dynamic behavior of plasmas scaled to near-Earth space conditions of interest. Space Chamber programs range from the basic physics driving plasma waves and instabilities in the ionosphere and magnetosphere, the large-scale evolution of plasmas in response to microscale physical processes, the development of innovative diagnostics for space and laboratory plasma use, remote sensing of plasmas, space situational awareness investigations, upper atmospheric effect simulations, and radiation belt dynamics. The Space Chamber is also large enough to accommodate spacecraft hardware for preflight testing in realistic environmental conditions.

Plasmas with diameters up to ~1.5 m can be produced within two integrated vacuum chamber sections: a 1.8-m-diameter, 5-m-long stainless steel main chamber and a 0.55-m-diameter, 2-m-long source chamber section. Water-cooled electromagnet coils provide an axial magnetic field of up to 250 G in the main chamber and up to 750 G in the source chamber section. A base pressure near 10^{-7} torr is maintained by cryogenic and turbo-molecular vacuum pumps. Plasmas with densities ranging from 10^5 to 10^{12} cm⁻³ can be produced from three available large-volume plasma sources.

INSTRUMENTATION: A wide variety of plasma diagnostics are available. Arrays of plasma impedance probes provide non-invasive real-time visualization of the 3D density structure via plasma impedance tomography. Laser-induced fluorescence gives non-invasive measures of velocity distribution. Conventional energy analyzers, emissive probes, and Langmuir probes are available to measure electron energy distributions and overall space potential of the plasma. The diagnostics are supported by a network of signal acquisition instrumentation, including digitizers, network and spectrum analyzers, and electrometers. The machine is fully automated to support long-duration experiments that run 24 hours a day.

The 5-m long main Space Chamber section is equipped with dual 3-axis translation stages, providing millimeter precision positioning of experimental hardware and diagnostics. Access for electrical, diagnostic, and manipulator vacuum penetration is available over most of the SPSC volume.

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