STRAY LIGHT

Design, Analysis & Testing

Stray light is an important factor and must be considered when designing space-based optical sensors. Radiation from off-axis sources, such as the Sun and Earth, enters the telescope aperture, where it scatters off system components and eventually reaches the focal plane. This stray light can degrade image quality and decrease the sensor's ability to detect faint signals.

With decades of experience in stray light design, analysis, and testing, engineers at the Space Dynamics Laboratory (SDL) design optical systems with stray light rejection in mind and know how to resolve issues discovered during testing.

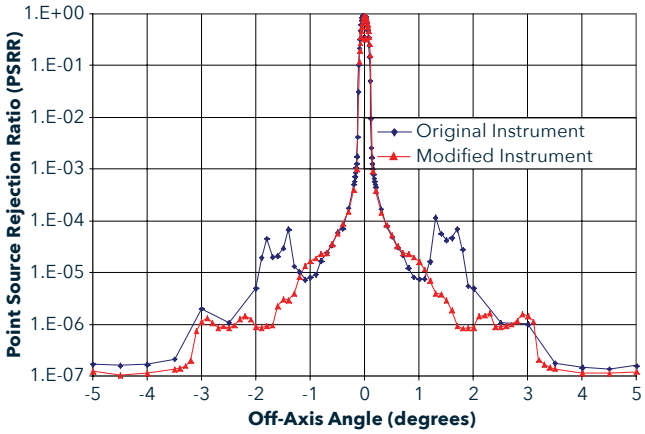
CAPABILITIES

Design & Software Analysis

- Assist with baffle design
- Verify stray light design through modeling
- Define scatter requirements for optical surfaces & coatings
- Optimize the optical system's stray light performance during the design phase through close collaboration between stray light analysts, mechanical engineers & designers

Testing

- Verify stray light design & measure performance
- Verify surface scatter properties



During testing, a major stray light path was discovered in a sensor. Since stray light rejection was critical at small off-axis source angles, a correction was applied. The before and after stray light performance is depicted above.

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SDL/18-1237 Rev. D

STRAY LIGHT Design, Analysis & Testing

SDL's end-to-end stray light capabilities and state-of-the-art facility reduce the risk of experiencing a stray light problem once a system is operational.

DESIGN & SOFTWARE ANALYSIS

Features

- Baffle design, including vane placement
- Non-sequential ray tracing
- Component- & system-level modeling & testing
- Exact modeling of mechanical objects
- Software tools: Zemax®, FRED™, MATLAB®
- Scatter properties library for optical surfaces & coatings
  - Optical surface roughness
  - Particulate contamination
  - Black paints

Types of Analysis

- Stray light rejection performance estimation: Point Source Transmission (PST), Normalize Detector Irradiance (NDI), etc.
- Reverse ray tracing to identify critical surfaces & important external stray light source locations in angle space
- Thermal self-emission (TSE) to assess the instrument's background thermal radiation
- Ghost analysis

Instrument under test mounted on a rotary table.

BLACK HOLE STRAY LIGHT MEASUREMENT FACILITY

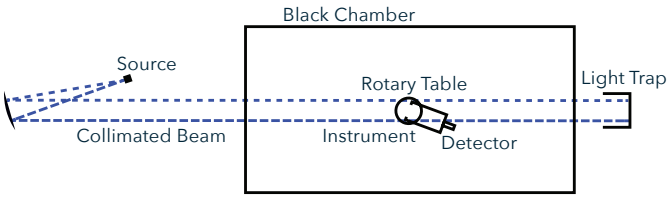
High off-axis rejection systems are difficult to characterize terrestrially due to scattered light from the test setup. SDL's large, specular black chamber dramatically reduces setup corruption by redirecting the scattered light away from the sensor's entrance aperture.

This is SDL's third-generation stray light measurement facility. SDL has tested numerous systems that have flown successfully in space.

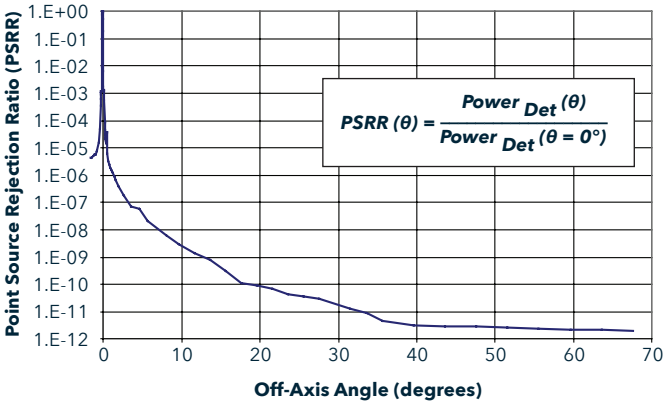
Features

- 100-foot dark cleanroom
- System-level stray light measurements at ultraviolet, visible & infrared wavelengths
- Automated data collection
- Data is reported in peak normalized form (PSRR) but can be easily converted to other forms such as PSRR/μsr & NDI
- Setup accommodates sensor apertures up to 18 inches
- Facility is reconfigurable to accommodate a variety of sensors & instruments

Test Setup



Demonstrated Performance



The off-axis response of the instrument under test was measured nearly twelve orders of magnitude lower from the peak on-axis response, demonstrating a very low noise floor.