# Case Study:

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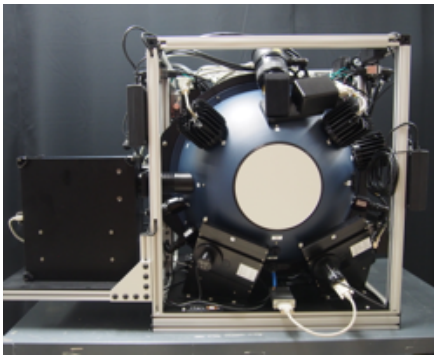


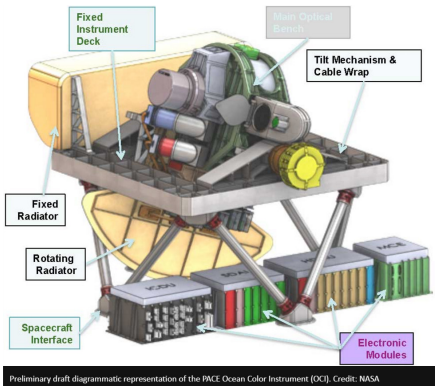

Preliminary draft diagrammatic representation of the PACE Ocean Color Instrument (OCI). Credit: NASA

Hyper Solar Radiance System:
A World-Record UV and Extra-Terrestrial Radiance Sphere Source for PACE Hyperspectral Instrument Calibration

## Technical Situation

The Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission will deliver the most comprehensive look at global ocean color measurements in NASA's history. Not only will PACE monitor the health of our ocean, its science data will expand atmospheric studies by sensing our skies over an exceptionally broad spectrum of wavelengths. The PACE Instrument is a next generation of hybrid hyperspectral (300-900nm) and multi-spectral space-born (900-2600nm) imager for scientific measurements of climate change monitoring (http://pace.gsfc.nasa.gov/).

A strategic climate continuity mission in support of NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space (2010), PACE will monitor aerosol particles, clouds, and many factors related to the marine carbon cycle including the phytoplankton pigment, chlorophyll. Moreover, PACE applications will help with many of our most pressing environmental issues such as harmful algal bloom and air quality forecasts.

## Business Challenge

Labsphere was asked to a radiometric characterization system based on Labsphere's HELIOS family of uniform sources that exceeded past records in radiant output in the UV-VIS-NIR and SWIR bands. The challenges in the specification arose from the high UV levels with very bright VIS-NIR levels that could help with "direct solar view" or reflectance of the sun off ocean surfaces. The system had to be fully automated and have a small foot print. The uniformity had to be extremely high across a swath of an 8" diameter exit port matching the scanning FOV of the instrument. The high UV had to be stable as the hyperspectral instrument uses a fixed integration time where temporal instability would interfere with scan validation.

## Labsphere's Solution

The most dynamic place to start from was the HELIOS A-Family due the customer's requirements for a solar-like source. Radiometrically, the levels were extremely challenging in the blue…and really across the entire spectral range…so it was quickly determined from modeling that this device had to be a Spectralon sphere (20" lined sphere). The amount of sources required also presented a hardware architecture, software and communication challenge to fit everything into a compact space.

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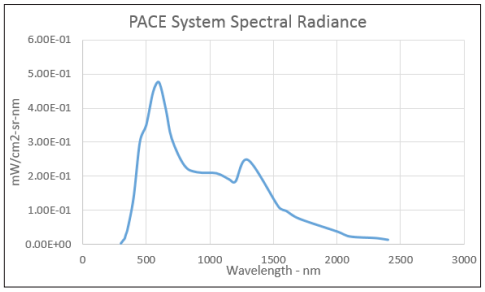
Additional requirements from the customer were met as follows:

- Using our innovative Plasma PEL-250 sources to provide the desired UV radiance and the temporal stability.
- Providing dual monitors silicon and extended InGaAs sensors to cover 320-2500nm.
- Meets hyperspectral requirements from 350-900nm.
- Meeting multispectral requirements for the NIR and SWIR regions (900-2400nm).
- Filter wheels on each detector and selected filters to match critical bands of interest for instrument performance.
- A calibrated spectral monitor from 300-800nm.
- Port for use with an additional spectrometer for longer wavelength ranges.
- HELIOSense Software to permit LabVIEWTM development and integration of components and systems at NASA.
- Thermal loading analysis
- Extra ports to support Laser inputs from GLAMR Laser Source
- Port to accommodate deep UV Source from Energetiq
- A compact HELIOS Sphere Cage and Rack system with special wall power requirements.



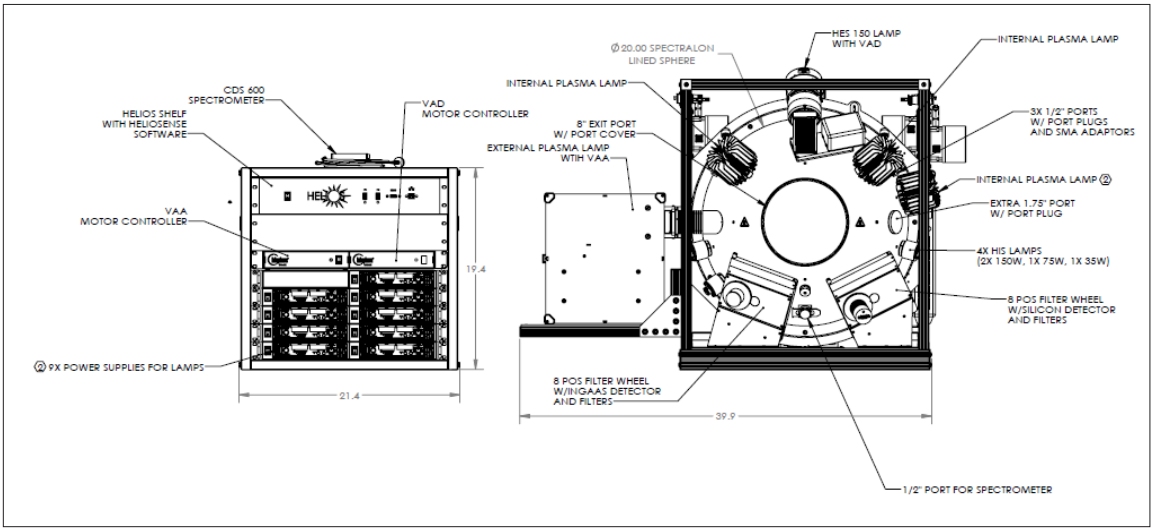

## Benefits

The system has been a great asset to the program.

The primary value to the customer has been the following

- Bespoke instrument tailored to the instrument performance for its science mission
- Extra-terrestrial UV levels
- Direct solar reflectance radiance emulation.
- Common control through HELIOSense software and single USB interface.
- Small form factor
- World record radiance values from a 20” sphere - Luminance >350,000cd/m2
- Modular design and options built in for incorporation with other systems for test expansion.

| Objective | Benefits Achieved |
|---|---|
| Tailor-made system for PACE Instrument needs | Test as you Fly, Fly as you test – low uncertainty. |
| Meet the Science Objectives of the Mission | Radiance levels met or exceeded in all areas |
| Multi-function instrument | Integrated All-in-One modular package with HELIOS hardware and HELIOSense software |
| Future flexibility | Adapt system to various needs |

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