

# Calibration & Test Group



(Courtesy LASP)

The LASP Calibration & Test Group (Cal Group) is involved throughout the lifecycle of an instrument's design and build. They provide a variety of services from instrument optical design and analysis, to characterization of optical and detector components, and instrument-level calibrations. The Cal Group is also responsible for the design, manufacture, operation, and maintenance of LASP test facilities. (Please see the Engineering Facilities sheet).

With more than 100 years of combined calibration and test experience, the LASP Cal Group has the diverse skill set necessary to understand the performance of spaceflight instrumentation, from component level to fully integrated instruments.

## Design and Analysis

The Cal Group supports scientists and instrument engineering design teams by providing a variety of design and analysis skills that include:

### Optical design and analysis

- Imagers, spectrographs, hyperspectral imagers, X-Ray-IR spectrometers, and photometers
- Industry standard software packages (e.g. Zemax and FRED)
- Stray light (non-sequential) analysis and optimization
- Radiometric sensitivity modeling
- STOP (Structural-Thermal-Optical-Performance)

### Magnetic models and analysis

- Electron rejection design and rejection efficiency modeling
- Strong (0.08 T) inner field, reduced (<30 nT) outer field

### Radiation dose models and analysis

- Full 3-D radiation shielding and dose analysis using SolidWorks models of instruments
- Material-dependent models (high-Z, low-Z)
- Radiation signal and noise contribution estimates at detectors

### Detector design

- Working with detector manufacturers to build custom diode arrays
- In-house electrical substitution radiometer (ESR) design

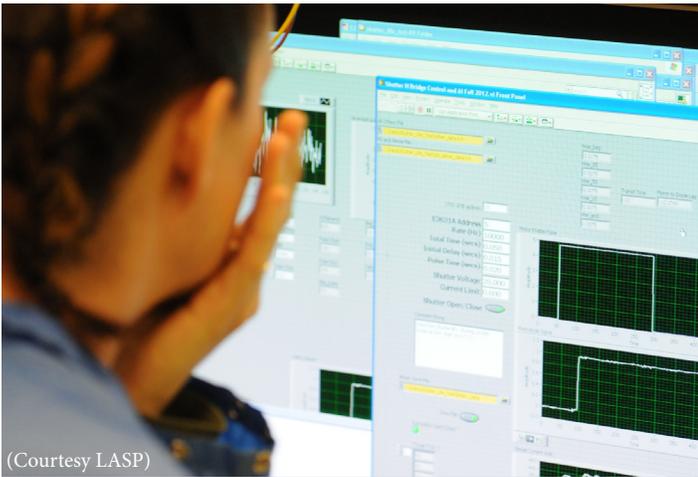
## Component Build

The Cal Group also provides performance testing of optical and detector components and subassemblies to ensure that the best units are selected for flight and that the components and subsystems meet their requirements. In these tests, calibration engineers design and fabricate the components of a test, set-up, automate, and operate an experiment, and analyze the resulting data to ensure the test is producing useful results.

Detector characterizations (performance, radiation hardness, and other qualification tests):

### Photomultiplier tubes (primarily photon counting)

- Pulse height distribution
- Counting curves
- Quantum efficiency vs. wavelength
- Photocathode spatial uniformity



(Courtesy LASP)

A LASP Calibration & Test Group engineer monitors real-time test data for component-level characterization.

- Sensitivity vs. temperature

#### Silicon diodes and diode arrays

- Shunt resistance
- Capacitance
- Radiant sensitivity vs. wavelength
- Spatial uniformity vs. wavelength

#### Image intensifiers

- Photocathode spatial uniformity vs. wavelength
- Sensitivity vs. temperature
- Quantum efficiency vs. wavelength and high voltage

#### Imaging arrays: Si CCDs and CMOS, HgCdTe CMOS

- Dark current and dark flat field
- Photo response non-uniformity
- Photon transfer (gain, linearity, and full well)

#### Electrical substitution radiometers (ESRs)

- Spatial uniformity vs. wavelength
- Radiant sensitivity vs. wavelength
- Thermal impedance
- Noise characterization
- AC/DC non-equivalence

#### Particle detectors

- Leakage current and capacitance
- Pulse height distribution
- Counting curves
- Charge collection time
- Dead layer uniformity

#### Filters: interference, thin-foil, bandpass

- In-band transmission
- Out-of-band rejection

#### Reflective gratings

- Relative/absolute efficiency

#### Optical component performance

#### Magnet assemblies

- Internal and far-field measurements
- <30 nT to 30 T measurement range
- Measurements correlated to magnetic models

## Flight Instrument Calibration and Characterization

At the end of the instrument production process, the optical system is aligned and the overall instrument performance is fully characterized both before and after the integration and test process prior to instrument delivery. The Cal Group supports both the alignment and instrument calibration process (whether it is performed in- or out-of-house) along with thermal vacuum and other integration tasks.

#### Instrument optical focus and alignment

- In-band characterization and adjustment of imaging properties

#### Absolute radiometric sensitivity

- Accuracy of 0.02–1%

#### Field-of-view maps (instrument performance as a function of angle)

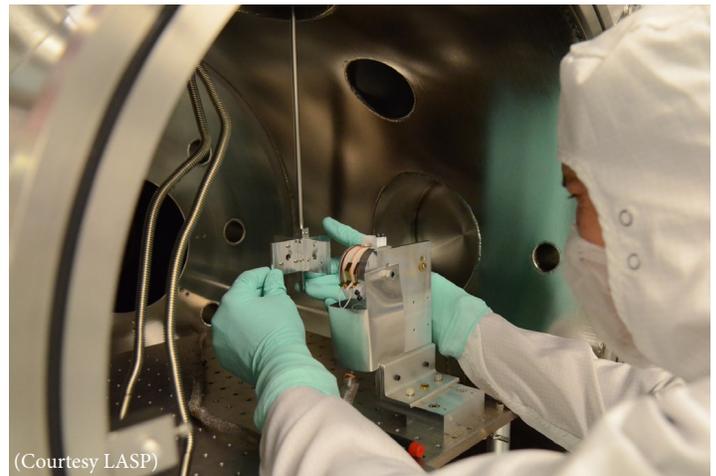
- In-band throughput variation by manipulating instruments in front of light source

#### Thermal testing

- Instrument-level thermal vacuum testing
- Characterize instrument performance under flight conditions

#### Zero-G relaxation measurements

- Theodolite, transfer mirror
- Measure relaxed state of instrument



(Courtesy LASP)

A LASP Calibration & Test Group engineer installs a component into a vacuum optical test facility.

To read more about the Calibration & Test Group, visit <http://lasp.colorado.edu/home/engineering/eng-capabilities/cal-test/>, call Ginger Drake at (303)492-5899, or email [ginger.drake@lasp.colorado.edu](mailto:ginger.drake@lasp.colorado.edu).

The Laboratory for Atmospheric and Space Physics (LASP) combines all aspects of space exploration through our expertise in science, engineering, mission operations, and data management. As an institute at the University of Colorado Boulder, LASP includes students throughout our activities. Learn more at <http://lasp.colorado.edu>.