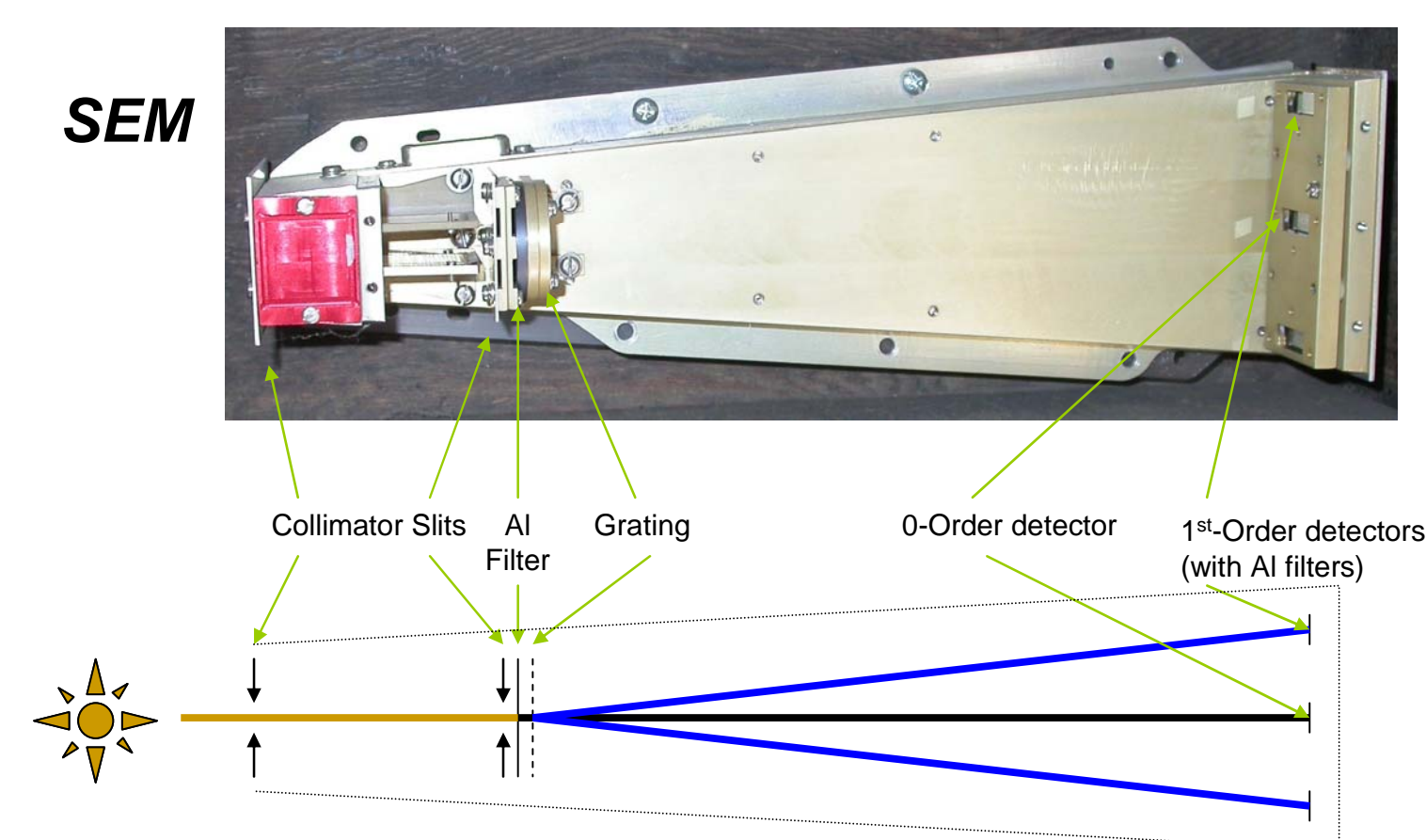




36.236US is the seventh flight of the USC payload to maintain the calibration of the SOHO Solar EUV Monitor (SEM). As well as the SEM we are flying several other EUV and soft X-Ray instruments as part of the payload.

## Instruments



The SEM was designed and built by the Space Sciences Center at the University of Southern California. A 5000 l/mm gold transmission grating developed at MIT acts as the dispersing element. A 150 nm thick free-standing Aluminum filter from Luxel limits the incident solar radiation to the 0.1 – 50 nm bandpass, this is measured with an IRD photodiode placed in the zero-order of the grating. Symmetrical 1<sup>st</sup>-order detectors (again IRD diodes) are placed behind a mask to define the 26 – 34 nm bandpass, centered on the He II 30.4 nm line. All the detectors also have a 150nm Al filter deposited onto the surface to further reduce white-light sensitivity. The entrance aperture is 2 × 10 mm.

The photodiode current is amplified and digitized using a voltage to frequency converter on the instrument itself. The timing and readout is handled by the power and data systems electronics.

### Photodiode Photometers

On this flight we have 4 photodiode photometers. These are IRD photodiodes with various metal-film filters. The filters used for this flight are:  
150nm Al (0.1 – 50nm)  
300nm Ti (0.1 – 5nm)  
5µm Be (0 – 1.2nm)  
50µm Be (0 – 0.7nm)

The photometers use an almost identical digitization scheme to the SEM detectors with ultra-low noise transconductance amplifiers and voltage to frequency converters.

### X-Ray Spectrometer

In conjunction with Scott Bailey at Virginia Tech. we are flying a commercial X-ray spectrometer. The Amptek X-123 X-Ray spectrometer uses a thermo-electrically cooled Si-PIN detector. The X-123 houses the detector, charge amplifier and pulse processor in a single small (7 × 14.45 × 2.5 cm) package. It is controlled by a commercial PC104 computer running Windows software developed at USC.

### Rare Gas Ionization Cell (RGIC)

The rare gas ionization cell provides the absolute integral solar flux in the ionization region of the working gas ( $\lambda < 57.5\text{nm}$  for neon). This cell is operated in the optically thick mode. The neon gas is periodically introduced and exhausted through an open (windowless) aperture in order to avoid any time dependent sensitivity changes associated with an accumulation of contaminant gas and/or time dependent window transmission. The absolute flux is proportional to the extrapolated current at zero density. Since the quantum yield is one for this instrument, and since no window is utilized, the rare gas cell used is a radiometric absolute detector. A similar cell (double ionization cell) was previously used by the National Institute of Standards and Technology (NIST) as the standard reference detector for VUV radiation. The electron-ion pairs formed in the gas cell by the absorption of ionizing EUV photons are collected and the ion current is measured using a highly stable electrometer. Knowledge of the absolute gas density is not required since the cell is optically thick at all wavelengths of interest.

The rare gas cell is ~ 1.30 m in length and completely absorbs all photons shortward of the ionization limit of the working gas. The diameter of the cell is 5 cm. The length and diameter of the cell were selected to provide an optically thick cell for EUV photons, and optically thin for the electrons produced in the photoionization process.

### Helium Double Ionization Cell (HDC)

The Helium Cell is similar in operation to the RGIC described above, except that the Helium Cell is operated in an optically thin mode. Helium gas is periodically cycled into the chamber, and exhausted through the windowless aperture. The ionization current is measured by two ion collectors, each approximately half the length of the cell, one in front of the other. Since the cell is operated optically thin, knowledge of the absolute gas density is required to complete the data analysis. This is accomplished with an ionizing radiation pressure gauge (RPG). The RPG is of the same design flown successfully by us on many sounding rockets, and comprises a small (~250 mCi) ScH<sub>3</sub> (scandium tritide) source which radiates a maximum of 18 KeV beta particles (electrons). The current due to ionization of the gas is measured throughout the flight, and compared to the current measured during pre-and post flight calibration with a reference pressure gauge.

### Video Cameras

We have two video cameras on board. A forward looking camera is used in ascent and descent phases, and a door-mounted camera looks back at the payload section during the observation period. These cameras provide a visual confirmation of the correct functioning of mechanisms, and are also used in undergraduate courses at USC.

### Power and Data Systems

Power and data handling for the entire payload is provided by custom designed electronics from Space Instruments. The system is split into two separate sections (for both power and telemetry) so that the loss of one section would not result in the loss of all data from the payload.

## Analysis

Before and after the flight the SEM instrument is calibrated on beam-line 9 at the Synchrotron Ultraviolet Radiation Facility (SURF) facility at NIST in Gaithersburg, MD.

The data from each instrument is corrected for the wavelength dependent atmospheric absorption using the MSIS model to provide "top of the atmosphere" fluxes, and these are then adjusted to the flux that would have been observed at 1AU. These values can then be compared to on-orbit instruments, especially the SOHO-SEM. The X-ray results are used to help understand the spectrum during the observation period and are useful in interpreting the central order response. They will also be compared to the measurements by the GOES XRS instruments for example.

The 36.236 is a joint launch with 36.233US from the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado, Boulder. 36.233US will be a calibration underflight for the TIMED EUV instruments, and the first flight of the SDO-EVE instrument. As such it provides a unique opportunity to provide cross calibration between SOHO-SEM, TIMED-SEE and SDO-EVE.

## Thanks

This work would not have been possible without the enthusiastic support of the whole NASROC and WSMR teams. They are a big part of what makes rocket science fun. Thank you!

Calibration at NIST is also a team effort, and we would like to thank the many support staff who always seem to accommodate our rushed schedules and unreasonable requests.

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