# FOS CALIBRATION PLAN FOR SMOV

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This instrument science report describes in detail the Servicing Mission Orbital Verification (SMOV) Calibration program for the Faint Object Spectrograph (FOS). A summary description of each program is given that includes proposal identification; estimated spacecraft time; primary targets (if any); detectors, apertures, and spectral elements used; and target acquisition techniques (if required). Also provided are the program abstract and scientific justification, a description of the observations, a summary of the primary program objective, and a listing of prerequisites and special requirements.

Companion FOS Instrument Science Report CAL/FOS-109 provides similar information for the Cycle 4 FOS Calibration program. These two documents provide the complete description of all calibration programs deemed necessary to provide an initial working calibration of the FOS in the post-COSTAR era.

The FOS SMOV program is divided into two phases: 1.) post-shuttle-departure but pre-COSTAR Deployable Optical Bench (DOB) deployment, and 2.) post-COSTAR DOB deployment.

In the former period the FOS is recovered to standard HOLD configuration, the internal pressure is measured and verified to be safe for High Voltage operation, brief tests are executed to assure normal hardware and electronic function of the instrument is available, a representative set of Y-bases are measured and compared with Cycle 3 values in order to assess the effect, if any, of the changed magnetic environment introduced by the presence of COSTAR, and, lastly, a set of baseline absolute sensitivity observations are obtained for direct comparison with Cycle 3 data.

Following COSTAR DOB deployment a thorough set of observations are planned to determine instrumental focus and X-pitch and Y-pitch; to measure Y-bases and aperture throughputs for all spectral elements; to determine FOS/FGS coarse and fine alignments; to measure aperture locations for all detector/aperture combinations; to establish a working internal wavelength calibration; to obtain initial absolute sensitivity measures; and to obtain superflat spectra for all spectral elements with both detectors.

The total spacecraft time required for the SMOV calibration program is 54.9 hours pointing on external targets and 25.1 hours of internal observations.

## TABLE 1: FOS SMOV CALIBRATION PLAN

| Proposal ID | Title | Accuracy | Results | Estimated SMOV Time (hours) | |
|---|---|---|---|---|---|
| | | | | On-target | Internal |
| 4761 | SMOV FOS Recovery to Hold | CHECK | N/A | 0.00 | 0.75 |
| 4762 | FOS Pressure Measurement | CHECK | N/A | 0.00 | 5.00 |
| 4802 | SMOV FOS/BL Initial Operations | CHECK | N/A | 0.00 | 1.50 |
| 4802 | SMOV FOS/RD Initial Operations | CHECK | N/A | 0.00 | 1.50 |
| 5243 | FOS Location of Spectra and Aperture: SMOV Tests | CHECK | PDB | 0.00 | 8.37 |
| 4259 | FOS Baseline Sensitivity Measurements | CHECK | N/A | 4.73 | 0.00 |
| 4907 | SMOV FOS/FGS Coarse Alignment | 0.5" | PDB | 4.38 | 0.16 |
| 4908 | SMOV FOS/FGS Fine Alignment | 0.05" | PDB | 17.16 | 4.10 |
| 4774 | SMOV FOS Internal Wavelength Calibration | 0.02 diode | RSDP | 0.00 | 3.67 |
| 4776 | SMOV FOS Flat Fields | 1% | RSDP | 20.99 | 0.00 |
| 4773 | SMOV COSTAR/FOS Sensitivity Measurement | 3% | RSDP | 7.67 | 0.00 |
| | | | **Total Hours** | **54.93** | **25.05** |

## Details of the SMOV Calibration proposals

Table 1 summarizes the SMOV tasks in the nominal order that the programs will be performed. The proposal identification and title, desired calibration accuracy, calibration database affected, and estimated spacecraft time are provided for each program.

### (1.) SMOV FOS Recovery to Hold

Proposal ID: 4761

Estimated total spacecraft time: 0.75 hours of non-prime time.

Primary Targets: N/A

Detectors: N/A

Apertures: N/A

Dispersers: N/A

Target Acquisition Technique: N/A

Prerequisites: None

Primary Objective:
To put FOS in HOLD mode.

Abstract:
This proposal executes the standard FOS recovery from SAFE mode. It has to be executed prior to any other FOS activities after the servicing mission.

Scientific Justification:
In order to re-establish the FOS science configuration it is necessary to return the FOS from the SAFE mode configuration used during the shuttle mission to a standard HOLD configuration. This transition is best done using the standard SAFE-HOLD commanding, which has been exercised during normal mission.

Description of Proposed Observations:
The transition from SAFE-HOLD for the FOS requires three DARK exposures. The first and the last exposures establish the SI configuration tables. The second exposure

line allocates 35 minutes to execute the SYRECOVER instruction, which actually commands the FOS from SAFE to HOLD configuration.

Special Requirements:
This activity must be the FIRST FOS activity after the completion of the shuttle portion of the servicing mission. There must be no other FOS activities between the proposed three exposures. The three exposure lines must be executed in the order given in the proposal. REAL-TIME engineering telemetry is needed during actual configuration.

Analysis Responsibility: J. Fitch

(2.) FOS Pressure Measurement

Proposal ID: 4762

Estimated total spacecraft time: 5.0 hours of non-prime time.

Primary Targets: N/A

Detectors: Blue and Red

Apertures: N/A

Dispersers: N/A

Target Acquisition Technique: N/A

Prerequisites: After successful completion of proposal 4761, i.e., after FOS has been be properly configured to HOLD mode.

Primary Objective:
To check the FOS aft shroud pressure after the completion of the shuttle portion of the servicing mission.

Abstract:
This proposal is designed to check the FOS aft shroud pressure after the completion of the shuttle portion of the 1993 servicing mission, and prior to the initial re-activation of either the FOS Red or Blue detector high voltage. This test will be run with the FOS in the LVON mode first on the Blue side and then on the Red side. The ion-gauge will be turned on for a minimum of 2.5 hours on each side until an internal pressure of 1.E-15 Torr or less is reached for 12 hours or more.

Scientific Justification:
In order to operate the FOS high voltage, it is necessary to ensure that the FOS internal pressure is sufficiently low to prevent high voltage coronal discharge. Such a discharge could destroy the FOS detectors. The FOS ION-GAUGE pressure measurements will allow the engineers to safely predict when the pressure constraint will be met.

Description of Proposed Observations:
The FOS low voltage and the ION-GAUGE will be turned on for at least 150 minutes every 12 hours to collect pressure information and then turned off. The observations will be monitored every 12 hours to identify trends and easily predict when the pressure criterion is satisfied. As a precaution against failures, the ION-GAUGE will be operated using both the Blue and Red sides within the 12 hour period. To minimize

the transitions within the FOS hardware, the ION-GAUGE will be turned on just prior to the 150 minutes of data collection, and turned off just after the data collection.

Special Requirements:
This activity must be performed after the successful completion of proposal 4761. The observations in the proposal must be repeated every 12 hours until all the pressure criteria are satisfied. No other FOS activities may be scheduled during the execution of the proposal.

Analysis Responsibility: J. Fitch

## (3.) SMOV FOS/BL Initial Operations

Proposal ID: 4802

Estimated total spacecraft time: 1.5 hours of non-prime time.

Primary Targets: WAVE, DARK

Detectors: Blue

Apertures: 0.1-PAIR-B

Dispersers: G190H

Target Acquisition Technique: N/A

Prerequisites: After successful completion of proposal 4761, i.e., FOS should be properly configured to HOLD mode, and after successful completion of proposal 4762, i.e., FOS internal pressure is below 1.E-15 Torr for a minimum of 12 hours.

Primary Objective:
To verify the FOS/BL science data interface and the proper functioning of the FOS.

Abstract:
This proposal will be used to obtain a DARK exposure and a WAVE cal lamp exposure to verify the science data interface and the proper functioning of the FOS. This proposal must be executed only after the pressure criterion for the FOS has been satisfied. This activity must be accomplished BEFORE any other use of the high voltage with the FOS Blue detector.

Scientific Justification:
Prior to the resumption of normal science activities with the FOS it is necessary to verify that the electronics and hardware within the instrument still function correctly. This will be accomplished by comparing a short series of internal images with images from the pre-servicing mission operations (proposal ID 4099).

Description of Proposed Observations:
Two internal exposures will be obtained with the FOS/BL detector. The DARK image will determine if the detector electronics worked correctly. The WAVE image will verify that the FOS optical path is still intact. As these images will include the first use of the FOS high voltage after the shuttle portion of the servicing mission, the data will be taken with REAL-TIME telemetry to ensure that problems are detected immediately.

Special Requirements:
REAL-TIME telemetry required throughout the observations to ensure that problems are detected and resolved quickly. The order of the observations is important.

Analysis Responsibility: J. Fitch

## (4.) SMOV FOS/RD Initial Operations

Proposal ID: 4803

Estimated total spacecraft time: 1.5 hours of non-prime time.

Primary Targets: WAVE, DARK

Detectors: Red

Apertures: 0.1-PAIR-B

Dispersers: G190H

Target Acquisition Technique: N/A

Prerequisites: After successful completion of proposal 4761, i.e., FOS should be properly configured to HOLD mode, and after successful completion of proposal 4762, i.e., FOS internal pressure is below 1.E-15 Torr for a minimum of 12 hours.

Primary Objective:
To verify the FOS/RD science data interface and the proper functioning of the FOS.

Abstract:
This proposal will be used to obtain a DARK exposure and a WAVE cal lamp exposure to verify the science data interface and the proper functioning of the FOS. This proposal must be executed only after the pressure criterion for the FOS has been satisfied. This activity must be accomplished BEFORE any other use of the high voltage with the FOS Red detector.

Scientific Justification:
Prior to the resumption of normal science activities with the FOS it is necessary to verify that the electronics and hardware within the instrument still function correctly. This will be accomplished by comparing a short series of internal images with images from the pre-servicing mission operations (proposal ID 4099).

Description of Proposed Observations:
Two internal exposures will be obtained with the FOS/RD detector. The DARK image will determine if the detector electronics worked correctly. The WAVE image will verify that the FOS optical path is still intact. As these images will include the first use of the FOS high voltage after the shuttle portion of the servicing mission, the data will be taken with REAL-TIME telemetry to ensure that problems are detected immediately.

Special Requirements:
REAL-TIME telemetry required throughout the observations to ensure that problems are detected and resolved quickly. The order of the observations is important.

Analysis Responsibility: J. Fitch

## (5.) FOS Location of Spectra and Apertures: SMOV Tests

Proposal ID: 5243

Estimated total spacecraft time: 8.37 hours of non-prime time.

Primary Targets: WAVE, TALED

Detectors: Blue and Red

Apertures: 0.3" circular, 0.1-Pair-B

Dispersers: G130H, G190H, G270H, G160L (Blue side before FOS mirror deployment)
G190H, G270H, G400H, G650L (Red side before FOS mirror deployment)
G130H, G190H, G270H, G400H, G570H, G160L, G650L, PRISM (Blue side after FOS mirror deployment)
G190H, G270H, G400H, G570H, G780H, G160L, G650L, PRISM (Red side after FOS mirror deployment)

Target Acquisition Technique: N/A

Prerequisites: After successful completion of FOS engineering tests, i.e., proposal IDs 4802, 4803

Primary Objective:
Part I: To determine the y-base of the FOS spectra on the photocathode. This test will verify that the location of spectra has not been dramatically affected by the servicing mission and the magnetic fields of COSTAR.

Part II: To verify if the focus has changed after the servicing mission, since the FOS focus is sensitive to external magnetic fields. If the focus has changed the X-pitch and the Y-pitch values will be re-determined.

Abstract:
Part I: Y-base maps will be obtained to determine the locations of spectra and the coarse aperture location for the 0.3" aperture using 4 grating settings ONCE BEFORE THE DEPLOYMENT of the FOS mirror and all gratings ONCE AFTER DEPLOYMENT of the mirror. This test has the highest priority because our ability to acquire spectra depends on our knowledge of y-base values. It should also be conducted as the FIRST CALIBRATION TEST for the FOS because a knowledge of the location of spectra is primary to FOS observations. The DX_DY_Y0 portion of the SICF.DAT file will be updated as required after each epoch of observation.

Part II: The FOS focus will be determined by obtaining spectra with the 0.1-PAIR aperture, G190H, and the Pt-Ne lamp. Once an optimal HV setting for the focus is determined and updates made to the PDB, a series of spectra at three different X-Bases will be made to determine the corresponding X-Pitch. Additionally, measurements with the TALEDs through the 0.1-Pair aperture will be used to determine Y-Pitch. This program may result in an instruction flow change to the detector high voltage setting, the X-pitch value, the Y-pitch value. The SICF.DAT file will be updated as required.

Scientific Justification:

Part I: Our ability to acquire FOS spectra depends on our knowledge of their location on the photocathode. Since each disperser/detector combination places the associated spectrum at a slightly different location on the photocathode this test has to be conducted for each disperser/detector combination. The y-base values determined from this test determine the magnetic field deflection required to acquire the spectra.

Part II: Our ability to obtain well calibrated data depends on every stage of data acquisition. A good instrumental focus is the first stage of the data acquisition process.

Description of Proposed Observations:

Part I: In this test, images will be obtained using the internal Pt-Ne lamps and TALEDs. Data will be obtained through the 0.3" aperture. The observations will map the face of the photo cathode using 24 y-steps and 1 x-step.

Part II: After high voltage warm-up, the trim current will be set to zero, and the detector HV to 22.66 (blue) or 21.6 (red). Spectra will be obtained with the following configuration: 0.1-PAIR lower aperture, grating G190H, 8 x-steps and 1 y-step, Pt-Ne lamp/direct. The HV will be increased and the observations repeated until the maximum voltage is 23.86 (blue) or 22.8 (red). If a change to the optimum HV setting is determined, and updated to the PDB, a series of exposures will be required to calculate the new X-Pitch and Y-Pitch values for the optimal HV setting. These will be obtained with the following configuration: 0.1-PAIR lower aperture, grating G190H, 8 x-steps and 1 y-step, Pt-Ne lamp/direct at three different X-bases. Then a map will be obtained with the following configuration: 0.1-PAIR lower aperture, camera mirror, 1 x-step 85 y-step TALED.

Special Requirements:

Part I: The program is to be performed in two sections, once before the deployment of the FOS COSTAR mirror and once after deployment. The high voltage MUST NOT (except possibly for SAA passages) be turned off once a sequence has begun.

Part II: The X-Pitch and Y-Pitch measurement observations have been flagged as COND ON <line> IF HV UPDATED. We will determine the need to execute these lines after the first set of observations have been obtained. These observations MUST occur during non-SAA impacted orbits.

The analysis of the data obtained in each section of the proposal will lead to a PDB update.

Analysis Responsibility: A. Koratkar and T. Wheeler

## (6.) FOS Baseline Sensitivity Measurements

Proposal ID: 4259

Estimated total spacecraft time: 4.73 hours of primary time

Primary Targets: BD+28D4211
Backup Targets: BD+75D325

Detectors: Blue and Red

Apertures: 4.3"

Dispersers: G130H, G190H, G270H, G160L (Blue side)
G190H, G270H, G400H, G650L (Red side)

Target Acquisition Technique: 4-stage ACQ/PEAK for an acquisition accuracy of 0.05".

Prerequisites: The pre-COSTAR epoch of SMOV y-base proposal 5243 must have been run, analyzed, and any required new values up-linked prior to execution of this proposal. FOS engineering must be checked out and HV re-enabled. Pointing control and guide star acquisition (coarse track) capabilities must be re-enabled.

Primary Objective:
To determine the effects of servicing on the FOS sensitivity before the deployment of the FOS COSTAR mirror.

Abstract:
A baseline measurement of the absolute sensitivity of the FOS detectors will be performed using UV standard star BD+28D4211. These data are to be obtained post-servicing but pre-COSTAR DOB deployment to determine the effects of servicing on the FOS sensitivity. These observations have been specified as Cycle 3 to ensure that the pre-SM FOS aperture names are used. The pre-COSTAR epoch of SMOV y-base proposal 5243 must have been run prior to execution of this proposal. No RSDP updates are planned based upon these observations.

Scientific Justification:
These measurements are to be obtained post-servicing , but pre-COSTAR deployment. They will be used to determine the effects, if any, of servicing activities on the sensitivity of the FOS.

Description of Proposed Observations:
Spectra of a UV standard star will be obtained in 4 blue detector and 4 red detector-grating combinations. To assure registration of the spectrum on the diode array, the

stars will be observed at 3 y-bases with an 8-10 micron separation. All of the spectra will be obtained in the 4.3 arcsec aperture. In the event that BD+28 (the preferred standard star) is not available (in SAZ late January through March), the same data can be acquired using standard star BD+75D325.

Special Requirements:
These data must be obtained before COSTAR deployment but after HST servicing. These data must also be obtained at the pre-SM secondary mirror nominal setting.

Analysis Responsibility: C. Keyes and R. Bohlin

## (7.) SMOV FOS/FGS Coarse Alignment

Proposal ID: 4907

Estimated total spacecraft time: 4.38 hours of primary time and 0.16 hours of non-prime time.

Primary Targets: NGC 188-225

Detectors: Blue and Red

Apertures: 4.3

Dispersers: N/A

Target Acquisition Technique: 2-stage 3X9 ACQ/PEAK, 2X6 ACQ/PEAK sequence

Prerequisites:
COSTAR FOS mirror should be deployed, i.e., successful completion of proposal 4815.

Primary Objective: To coarsely determine, (1) the location of the 4.3" aperture, (2) the scale and orientation of the detectors.

Abstract:
Coarse position of 4.3 aperture will be determined for FOS/RED and FOS/BLUE. A large, two-stage ACQ/PEAK sequence will be used initially to acquire a target and will be followed by confirming ACQ images at the derived aperture position. Confirmation of UPLINKed telescope movements and POS TARG movements in X and Y will also be made to determine the scale and orientation uncertainties. The SIAF.DAT file will be updated as required.

Scientific Justification:
The knowledge of the location of the apertures relative to the FGS is crucial to any target acquisitions/observations with the FOS.

Description of Proposed Observations:
Initially, a large 3x9 ACQ/PEAK scan pattern of FOS/RED MIRROR observations with the 4.3 aperture followed by a standard 2x6 ACQ/PEAK MIRROR sequence in the 1.0 aperture will be performed. The search pattern will cover a 10.8 x 10.8 arcsec area. A confirming ACQ IMAGE will be obtained. This should coarsely locate the position of the 4.3 aperture. Next an UPLINKed telescope move will be commanded and an ACQ IMAGE taken. This will help determine scale and orientation uncertainties (coarsely). Next a POS TARG offset of 0.5 arcsec will be made in X and a new ACQ IMAGE will be obtained. This will allow confirmation that X-motion is oriented as expected. Then a

POS TARG of 0.5 arcsec in Y will be made and another confirming ACQ IMAGE made in order to determine orientation of Y-motion. Finally, the entire procedure with the exception of the UPLINK sequence will be repeated with FOS/BLUE.

Special Requirements:
REAL-TIME observations and analysis are an absolute requirement so that positioning updates can be performed between steps of the aperture-location procedure. PDB SIAF.DAT file will be updated.

Analysis Responsibility: A. Kinney

## (8.) SMOV FOS/FGS Fine Alignment

Proposal ID: 4908

Estimated total spacecraft time: 17.16 hours of primary time and 4.10 hours of non-prime time.

Primary Targets: NGC 188-225
NGC 4374
DARK

Detectors: Blue and Red for all parts of the proposal

Apertures: 4.3" square , 1.0" circular, 0.5" circular, 0.3" circular, 1.0" pair, 0.5" pair, 0.25" pair, 0.1" pair, 0.25"X2.0" slit, 2.0" bar, 0.7"X2.0" bar.

Dispersers: N/A

Target Acquisition Technique:
Part I: Interactive acquisition followed by an ACQ/PEAK

Parts II & III: ACQ/BIN followed by an ACQ/PEAK

Prerequisites:
Part I: COSTAR/FOS Fine Alignment Tilt (proposal ID 4747) should be successfully completed and the COSTAR mechanisms should be in the final SMOV positions.

Part II: FOS/FGS Fine Alignment (Part I) should be successfully completed and the results of the analysis updated in the PDB.

Part III: FOS/FGS Fine Alignment (Part I) should be successfully completed and the results of the analysis updated in the PDB.

Primary Objective:
Part I: To determine the precise location of the FOS apertures relative to the FGS.

Part II: To determine the precise plate scales and orientations of both the FOS detectors.

Part III: To determine the precise locations of all the FOS apertures relative to each other, and the aperture throughput ratios.

Abstract:
This proposal has three parts. ACQ IMAGES will be obtained at each acquisition to determine the acquisition accuracy. The goals of each part are as follows:

Part I: To determine the Fine FOS/FGS alignment. A TALED image in the 0.3 followed by an INT ACQ and a confirming ACQ image in the 4.3 will be obtained. Lastly, a fine ACQ/PEAK and confirming ACQ IMAGE will be taken. PASS reports will be analyzed in conjunction with the observations to allow determination of (V2,V3) positioning. The SIAF.DAT file will be updated as required.

Part II: To measure the precise plate scale and orientation. This will be achieved by performing a raster step and dwell sequence in the 4.3 arcsec aperture. The edges of the aperture should be avoided to prevent vignetting effects. This test has to be conducted for both the RED and BLUE detectors. We will also determine the offset between the two detectors. The DX_DY Table of the SICF.DAT file will be updated as required.

Part III: To measure the precise aperture locations and sizes. Aperture maps of the TALEDs and an elliptical galaxy with a flat energy distribution in the nucleus which uniformly fills the apertures will be used to roughly determine the location of the apertures. Next the precise aperture locations will be determined by performing a raster step and dwell sequence in the FOS apertures along the edges of the apertures. This test has to be conducted for both the RED and BLUE detectors. The analysis of the observations will result in database changes to the table of aperture locations in the SIAF.DAT file as required.

Scientific Justification:
Precise location of the FOS apertures relative to the FGS and to each other, and precise plate scale are important for successful target acquisition.

Description of Proposed Observations:
Part I: First a TALED FOS/RED ACQ IMAGE of the 0.3 aperture will be obtained. Next an INT ACQ on a star in an astrometric field in NGC 188 with the 4.3 aperture will be performed. Then, a confirming ACQ IMAGE of the field will be made with the 4.3 aperture. Lastly, a fine 5x5 ACQ/PEAK with the 0.3 aperture and a confirming ACQ IMAGE will be taken. PASS reports will be analyzed to determine (V2,V3) pointing of the exposures to assess fine positioning of the FOS aperture. The entire procedure will be repeated with FOS/BLUE

Part II: Since the FOS apertures are nested about the same position on the photocathode, an accurate plate scale and orientation cannot be derived as for the other instruments with widely separated apertures, as projected on the photocathodes. Therefore, the precise FOS plate scale and orientation will be determined as follows: Perform a raster step and dwell sequence in the 4.3 arcsec aperture, using a 0.775 arcsec step size on a 3.1X3.1 arcsec grid. The edges of the 4.3 arcsec aperture should be avoided to prevent vignetting effects. An aperture map is required at each step in the dwell sequence. Since the target will be accurately centered for the raster scans in both the red and blue detectors, we will simultaneously determine the offsets between the two detectors.

Part III: In the first part of the aperture location test the aperture locations will be determined from aperture maps of the TALEDs and an elliptical galaxy with a flat energy distribution in the nucleus which uniformly fills the apertures. This flat distribution will be used to roughly determine the edges of the apertures. This will also simultaneously measure the mean sizes of the FOS apertures and the relative throughput as long as the flat field source is constant over the time between aperture maps. Next the precise aperture locations of the small apertures will be determined by performing a raster step and dwell sequence in the apertures along two perpendicular directions in the apertures to find the maximum throughput for the small apertures. This technique provides the most precise (V2,V3 ) locations. The imaging of the large apertures and the dwell scans of the small aperture will provide the most precise locations of the apertures in the (V2,V3 ) frame and relative to each other.

Special Requirements:
Part I: Interactive acquisition is an absolute requirement for the FOS/FGS fine alignment part of the proposal, so that positioning updates can be performed as necessary between the steps of the fine alignment procedure.

Part II: This part of the proposal should be scheduled after the FOS/FGS fine alignment portion. An aperture map is required at each step in the dwell sequence. The FGS encoder values are to be extracted and recorded during the step and dwell sequences. The center point in the spatial scan should have the object centered in the aperture. Pointing stability of 10% of the smallest aperture (0.1") used - 0.01" - is required for the FOS data. Analysis of this data will lead to an update of the relevant PDB file.

Part III: The aperture location (imaging and dwell scans) part of this proposal should be scheduled after the FOS/FGS fine alignment portion. The TALED and external maps of any specific aperture must be obtained NON-INT due to the floppy nature of the filter-grating wheel. The overlight limit must be set to the default value for non-mirror observations (12 million), even though the MIRROR is used. All observations in this program MUST occur in non-SAA impacted orbits. Analysis of this data will lead to an update of the relevant PDB file.

Analysis Responsibility: A. Kinney and A. Koratkar

## (9.) SMOV FOS Internal Wavelength Calibration

Proposal ID: 4762

Estimated total spacecraft time: 3.67 hours of non-prime time.

Primary Targets: WAVE

Detectors: Blue and Red

Apertures: 0.1-PAIR-B, 0.25-PAIR-B, 0.3" circular

Dispersers: G130H, G190H, G270H, G400H, G570H, G160L, G650L, PRISM (Blue side, 0.3" circular)
G270H, G400H, G650L, PRISM (Blue side, 0.1-PAIR-B)
G130H, G190H, G570H, G160L (Blue side, 0.25-PAIR-B)
G190H, G270H, G400H, G570H, G780H, G160L, G650L, PRISM (Red side, 0.3" circular)
G270H, G400H, G570H, G780H, G650L (Red side, 0.1-PAIR-B)
G190H, G160L, PRISM (Red side, 0.25-PAIR-B)

Target Acquisition Technique: N/A

Prerequisites:
The post-COSTAR epoch of SMOV y-base proposal 5243 must have been run, analyzed, and new values up-linked prior to execution of this proposal. FOS/FGS Fine Alignment must be completed (prop 4908) and the update to PDB SIAF must also be completed.

Primary Objective: To determine the FOS wavelength scale for all disperser/detector combinations. and determine the FOS line spread functions.

Abstract:
These internal wavelength calibration data will be obtained during SMOV to ensure the stability of the FOS wavelength scale through the servicing mission. All standard gratings will be used with the 0.3" circular and either the 0.1" or 0.25" paired apertures. The cyccsbr relation of the RSDP will be updated as required.

Scientific Justification:
These observations will determine the FOS wavelength scale for all disperser/detector combinations.

Description of Proposed Observations:
Measurements of the Pt-Ne lamp will be obtained with both FOS detectors. The observations, taken through the smallest square (0.1-PAIR) and circular (0.3) apertures, will be used to determine accurate wavelength scales for all disperser/detector combinations as per CAL/FOS-48 (Oct. 1988) by Hartig.

Special Requirements: None

Analysis Responsibility: C. Keyes

## (10.) SMOV FOS Spectral Flat Fields

Proposal ID: 4762

Estimated total spacecraft time: 20.99 hours of primary time.

Primary Target: G191-B2B

Detectors: Blue and Red

Apertures: 4.3" square, 1.0" circular, 0.5" circular, 0.3" circular, 1.0-PAIR, 0.25-PAIR

Dispersers: G130H, G190H, G270H, G400H, G160L, PRISM (Blue side)
G190H, G270H, G400H, G570H, G780H, G160L, G650L, PRISM (Red side)
G270H (Blue side 1.0 circular, 0.5 circular, 0.3 circular, 1.0-PAIR, 0.25-PAIR)
G190H (Red side 1.0 circular, 0.5 circular, 0.3 circular, 1.0-PAIR, 0.25-PAIR)

Target Acquisition Technique: 4-stage fine ACQ/PEAK for an accuracy of 0.03".

Prerequisites:
The post-COSTAR epoch of SMOV y-base proposal 5243 must have been run, analyzed, and new values up-linked prior to execution of this proposal. FOS/FGS Fine Alignment must be completed (prop 4908) and the update to PDB SIAF must also be completed.

Primary Objective: To calibrate the diode-to-diode variations in the FOS detectors.

Abstract:
The pre-COSTAR diode-to-diode variation and photocathode non-uniformities of the FOS detectors were well-determined for spectra obtained through the single apertures via the superflat technique that produces a template super-flux energy distribution of a relatively featureless stellar spectrum at the instrumental resolution of the 4.3 aperture. Since instrumental resolution will have changed dramatically post-COSTAR for the 4.3 aperture, we must obtain new super-flux spectra. This set of observations will produce flat field calibrations appropriate to the post-servicing time period. High S/N spectra are obtained for G191-B2B, which has a relatively featureless spectrum and which has been the primary target for pre-servicing flat field observations. Observations are made through the 4.3 arcsec square with all usable detector/disperser combinations. Observations through several other small apertures and the G190H (redside) and G270H (blueside) will also be obtained to verify that the flats obtained through the large aperture are similar to flats obtained through the small aperture. The cyfltr relation of the RSDP will be updated as required.

Scientific Justification:
To determine the post-COSTAR diode-to-diode variation and photocathode non-uniformities of the FOS detectors. Photocathode granularity determined from comparison of observations at any post-COSTAR epoch with these derived super spectra will provide flat fields free of the systematic errors introduced by earlier techniques which required subjective analytical techniques.

Description of Proposed Observations:
POS_TARG positioning at 7 different x-positions will be used to shift the location of the spectra in the dispersion direction, so that intrinsic features of the stellar spectrum can be distinguished from detector nonuniformities. The data also will be obtained with three ysteps, to assure photometric accuarcy, since the same data are also useful for inverse sensitivity calibration. Data will be used to update the cyfltr relation in RSDP files as required.

Special Requirements: None

Analysis Responsibility: C. Keyes

## (11.) SMOV COSTAR/FOS Sensitivity Measurements

Proposal ID: 4773

Estimated total spacecraft time: 7.67 hours of primary time.

Primary Target: G191-B2B
Backup Target: BD+28D4211

Detectors: Blue and Red

Apertures: 4.3"

Dispersers: G130H, G190H, G270H, G400H, G160L, PRISM (Blue side)
G190H, G270H, G400H, G570H, G780H, G160L, G650L, PRISM (Red side)

Target Acquisition Technique: 4-stage ACQ/PEAK for an acquisition accuracy of 0.03".

Prerequisites:
The post-COSTAR epoch of SMOV y-base proposal 5243 must have been run, analyzed, and new values up-linked prior to execution of this proposal. FOS/FGS Fine Alignment must be completed (prop 4908) and the update to PDB SIAF must also be completed.

Primary Objective: To determine the effects of the FOS COSTAR mirror on the FOS sensitivity after the deployment of the FOS COSTAR arm, and to determine the absolute photometric calibration of the FOS.

Abstract:
A measurement of the absolute sensitivity of the FOS detectors will be performed using UV standard star G191-B2B. The highest priority gratings will be used in the 4.3 arcsec aperture. These data are to be obtained post-deployment of the FOS COSTAR arm to determine the effects on the FOS sensitivity. The cyivsr relation of the RSDP will be updated as required.

Scientific Justification:
These measurements will determine the need for full photometric re-alibration of the FOS following SMOV.

Description of Proposed Observations:
Spectra of a UV standard star will be obtained in 6 blue detector and 8 red detector-grating combinations. To assure registration of the spectrum on the diode array, the stars will be observed at 3 y-bases with an 8-10 micron separation. All of the spectra will be obtained in the 4.3 arcsec aperture. In the event that G191-B2B (the preferred

standard star) is not available (in SAZ mid-April through July), the same data can be acquired using standard star BD+28.

Special Requirements: None

Analysis Responsibility: C. Keyes and R. Bohlin