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Modifications to/Reordering of Vacuum Alignment Procedure

Rev. B

Illumination Philosophy

1. Configure the SRS to deliver to the FFUSS a factor of 2 demagnified image of either: a) a 1 mm pinhole in front of a source lamp such as Krypton, Xenon, or Mercury; or b) the roughly 2 mm emission core of a Pt/Cr/Ne line lamp.

2. The 1 mm pinhole will produce a 0.5 mm image at the entrance to FFUSS for use in throughput measurements. The 2 mm Pt lamp source will produce a 1 mm image at the entrance to FFUSS (and the same at the slit plane of STIS), corresponding to a roughly 4 arcsecond diameter field at the STIS entrance slit.

PRE-PUMPDOWN AIR TEST

NOTE: MAMA engineers should observe the valid event/total event ratio for whatever images in this sequence are of interest to them. None are the large spots that the MAMA engineers would like. We will get better data on the event ratio in vacuum vs. atmospheric pressure at the end of the test by comparing data taken in vacuum with data taken immediately after a nitrogen backfill.

1. Do a visual vignetting check with the IM subsystem calibration lamps, krypton, deuterium, and Pt. With the MSM configured to Mode 3.6 and large aperture 10 at the slit wheel, turn on the cal lamps briefly in turn and verify with a card in the CCD path that the lamps have the expected unvignetted field.

2. Complete STIS-OAT-053 Section 7.5 "PMT Radiometer Alignment to FFUSS Beam", using the Hg penray lamp.

3. If the unattenuated Hg lamp count rate on the PMT is greater than about 10^6 counts/second (i.e., if you're getting 10^4 counts/second with an ND2 filter), then there should be enough counts on the MAMA to do alignment to the FFUSS/SRS in air, rather than nitrogen.

4. Using the Hg lamp, following the flow of OAT-053 Section 7.4 "FFUSS/SRS GN2 Alignment Verification to STIS", verify that the FFUSS/SRS image is properly centered in the STIS field using camera mode 1.6 exposures with large aperture 1 and small aperture 21.

5. If a sufficient count rate can not be obtained with the Hg lamp, try these same steps with

the deuterium continuum lamp (which produces flux at wavelengths where the CsI MAMA has more efficiency, but where the atmospheric attenuation is greater).

6. With whichever lamp provides a reasonable count rate through small STIS apertures, carry out Section 8.4 "MSM and Slit Wheel Repeatability Test". Note the following changes:

--In the MSM repeatability section, we will not be able to see an image in any of the dispersed modes (using Hg wavelengths). Hence, the verification will consist of evaluating the repeatability of the mode 1.6 pointing with motions to other modes (including non-zero scan angles) in between. A reasonable order would be: modes 1.6, 1.2p11, 1.6, 1.3, 1.6, 1.2p1, 1.6, 1.4p3, 1.6. All at slit 21.

--In the slit wheel repeatability section, we will not use slit 34 because of the small field being provided by the FFUSS/SRS. The slit sequence should be: 20, 21, 20, 21, 16, 21, 20, 16, 24, 21.

7. Carry out a short test to confirm the orientation of the MAMA image readout with respect to real physical coordinates. In Mode 1.6, with slit 21 (just like the last exposure in step 6):

--Command the MSM to an elevation of +0.1 degrees above the nominal Mode 1.6 pointing. Take an image. Observe which direction the image moved.

--Command the MSM to the nominal elevation, with an azimuth of +0.1 degrees above the nominal Mode 1.6 pointing. Take an image. Observe which direction the image moved.

8. Return the MSM to its nominal Mode 1.6 pointing. Take a final pre-pumpdown image through slit 1 (clear), with the 1 mm pinhole in front of the Hg lamp. This will serve as a reference for comparison with the first post-pumpdown image, to indicate whether the beam moved during the pumpdown (and thus whether we should be worried about the centering of the beam on the PMT).

VACUUM TEST MODIFICATIONS

8.1 Band 1 Optical Throughput (Kr) - Preliminary Check

No FFUSS pinhole. 1 mm pinhole in front of the krypton lamp in the SRS.

DO NOT MOVE THIS PINHOLE BETWEEN THE FINAL PRE-PUMPDOWN IMAGE AND THE FIRST POST-PUMPDOWN MAMA IMAGE. Keep in mind that the required ND filter may well be different with the krypton lamp, so remember to do the careful ramp up from safe ND values, as written.

The throughput data are best taken when the spectral formats have been properly centered and wavelength calibrated. We take a small amount of preliminary data here for two purposes:

--verify the post-pumpdown vs. pre-pumpdown pointing by taking images through the 1 mm pinhole

--establish a throughput baseline at the beginning of the vacuum test so that we can check for contamination effects over the test period

For this preliminary check, take only 3 of the MAMA exposures called out in Section 8.1:

--Mode 1.6 (provides the pointing check)
--Mode 1.1 (provides throughput in a mode where the spectral content can be seen)
--Mode 1.7x3 (provides throughput in a folded mode with two more reflections)

For the first order exposures, confirm that the MSM tilt is such that the weak secondary line at 1165 Å is on the detector so that the contribution to the rate from that line can be estimated.

8.3 <u>Band 1 Focus and Wavelength Position Tests</u>
8.5 <u>Band 1 Scan Positions</u>
8.8 <u>Echelle Cross Disperser Scans</u>
8.9 <u>Band 1 Selected Retests</u>

The two main purposes of this entire group of sections are 1) to determine and verify proper MSM pointing values for all modes, and 2) to evaluate image quality/spectral resolution over the full detector format for all modes (i.e. over the full long slit field of view for first order modes). We will also get a lot of data on stray light performance as a fringe benefit.

We need to keep those primary goals distinct and accomplish each in the proper order, with the illumination source best suited to the purpose. That framework suggests the following order and choice of exposure configurations for the tests.

NOTE: SEVERAL PORTIONS OF THIS PROCEDURE REQUIRE SIGNIFICANT DATA ANALYSIS. DO NOT LET DATA ANALYSIS HOLD UP THE TEST FLOW. GO ON TO OTHER PORTIONS OF THE PROCEDURE THAT ARE NOT DEPENDENT ON THE PARTICULAR ANALYSIS RESULTS (i.e. get into the long slit resolution exposures with the IM Pt lamp, if the echelle mode analysis is not yet complete).

a) Make a first run through of all the first order and camera mode exposures in sections 8.3 and 8.5, using the SRS Pt lamp. Because we will only be illuminating a small part of the MAMA field, we will need to use small slits, whose edges can be seen, in order to properly determine the MSM pointing in the spatial direction. We will do one long slit exposure in mode 1.1 and 1.7x3 in order to determine any pointing offset between the nominal long slits for these modes and the small slits we will be using for this test.

-- take one exposure in mode 1.1 with long slit 34; then
-- for modes 1.1, 1.2, 1.6, and 1.6f: use slit 25 (0.063" x 1.0") [0.063" in dispersion]

-- take one exposure in mode 1.7x3 with long slit 51; then
-- for modes 1.7x3 and 1.7x4: use slit 27 (0.5" x 0.2") [0.2" in dispersion]

Science team: When figuring out the pointing correction for the modes, calculate the correction so as to center the spectra when using the 2-pixel long slits (34 and 51). Shouldn't be very different from the centering for slits 25 and 27, but check just in case.

b) For echelle modes 1.3 and 1.4, at the nominal central wavelength in the cross-dispersion direction, do the Section 8.8 cross-disperser scans along the echelle orders in order to determine the proper pointing in the echelle blaze direction. Use the SRS Pt lamp for these measurements.

-- move to larger slit (e.g. slit 21) if count rates are prohibitively low; we are after blaze profile, not resolution, in this test.

c) When the first order mode pointing corrections have been calculated and new MSM values derived, take exposures with those new MSM settings and verify proper pointing. Again use the SRS Pt lamp.

d) With the best guess echelle mode centering in the elevation direction, take IM krypton lamp exposures in modes 1.3 and 1.4 p2 (steps 8.7.16 to 8.7.19). *Remember to check the count rate with a small slit before moving to a higher count rate slit.* The continuum spectrum provides another means of evaluating the centering of the echelle blaze. Use a slit to give as high a safe count rate as possible without order confusion (slit 27, 0.5" x 0.2" is a good guess).

e) When the best cross-disperser elevations have been derived for the echelle modes, take exposures at all the primary and intermediate scan positions, using the SRS Pt lamp and slit 19. (We have already centered the blaze to the extent possible using the data from step b; now we need to get the right MSM pointing in the cross-dispersion direction.)

f) Fit the wavelengths and derive pointing corrections in the cross-dispersion direction. Take exposures with the SRS Pt lamp and slit 19 at all primary and intermediate positions (Step 8.5.8).

g) Switch to the mono-isotopic Pt lamp and take the following images in mode 1.4:

-- p1
  slit 20 (0.09") repeller ON
  slit 19 (0.063") "
-- p3
  slit 19 (0.063") "
  slit 20 (0.09") "
-- p2
  slit 20 (0.09") "

slit 19 (0.063")	"	
slit 19 (0.063")	repeller OFF	
slit 30 (0.025")	repeller OFF	ultimate resolution test

h) Do steps 8.7.1, 8.7.2, and 8.7.3 (IM Pt lamp checkout) in order to determine safe operating procedures for the internal lamp prior to doing the long slit resolution mapping with it.

In step 8.7.3.5, the timetag turnon test at 1 mA must be done with the *same* slit as used in 8.7.3.3, because the lamp will briefly run at 10 mA before cycling down to 1 mA. Pick a timetag exposure time that will generate < 4 million events so as not to overflow the buffer memory.

Then, using the "safe Pt 1 mA" PSTOL (CIM out--lamp on--CIM in) take a wider slit exposure (probably 0.5" width) at the 1 mA current setting in order to get a good measurement of the spectral intensity of the lamp at that current.

i) Using the Pt lamp in the IM system, take long-slit exposures with the appropriate 2-pixel wide slits (34 and 51) for all first order modes and mode 1.6 in order to evaluate resolution over the full field. *(For mode 1.6, we are likely to violate the local count rate limit with a clear 2-pixel slit. We will likely need to take these exposures through the ND filtered long slits 61 and 65.)*

8.2 Band 1 Optical Throughput (Xe) - Thorough Check

No FFUSS pinhole. 1 mm pinhole in front of the xenon lamp in the SRS.

Take these exposures at the properly centered MSM positions.

In order to determine the transmission of the filters vs. wavelength, take the filtered exposures in Mode 1.1, not Mode 1.6f, immediately following the Mode 1.1 aperture 10 (clear) exposure.

for the filters, do:
-- aperture 2 (Lyman alpha) may get upper limits only
-- aperture 3 (quartz)
-- aperture 7 (SrF2)

8.1 Band 1 Optical Throughput (Kr) - Thorough Check

No FFUSS pinhole. 1 mm pinhole in front of the krypton lamp in the SRS.

First, take the same exposures as done at the beginning of the vacuum test, at the same MSM positions as the earlier data, to check for any throughput changes.

Then, take the full series at the properly centered MSM positions.

8.1.25 Do the exposures through the Lyman alpha and SrF2 filters using Mode 1.1, not Mode 1.6f. Do them immediately following the Mode 1.1 aperture 10 (clear) exposure. This will enable us to measure transmission of the filters at the 1236 line without confusion from other wavelengths.

for the filters, do:
-- aperture 2 (Lyman alpha)
-- aperture 7 (SrF2) likely to get only an upper limit at 1236

8.7 <u>Cal Subsystem Throughput</u>

Steps 8.7.1, 8.7.2, and 8.7.3 will have been completed above.

Following are some comments on the other steps in this section of the OAT-053 procedure:

<u>8.7.4</u> Use the "safe Kr" PSTOL (CIM out--lamp on--CIM in, then MAMA exposure) to take these exposures. Go for a slit that gives a few thousands but less than 15,000 counts/second total (not a few thousand counts/sec/pixel as written in the procedure).

<u>8.7.5</u> At the slit position found in 8.7.4, take a 3 minute time tag exposure (180 seconds x 15,000 cts/sec = 2.7 million counts, which will fit in buffer memory).

<u>8.7.6</u> Use the "safe Kr" PSTOL. *This would be a good exposure for the MAMA engineers to take vacuum data on the valid event/total event ratio.*

<u>8.7.7</u> Let the deuterium lamp warm up 5 minutes and check the rate. Pick a slit that will yield 1,000-10,000 counts/second after the warm up period.

<u>8.7.8</u> Take 6 minutes of time-tag data (360 seconds x 10,000 cts/sec = 3.6 million events, which fits in buffer memory).

<u>8.7.9 and 8.7.10</u> OK as written.

<u>8.7.11</u> This exposure will take a comparable ND filter to what was required for the Mode 1.1 krypton lamp exposure. It is likely to need slit 64 or 65 (ND-filtered), not clear slit 51.

<u>8.7.12 and 8.7.13</u> The order should be as follows:

--Take krypton lamp exposures at the first MSM setting, building up to the highest safe count rate slit.

--Take the Pt lamp exposure through that same slit (unless the ND is prohibitively high--in that case, use the best count rate 2-pixel slit for mode 1.7x4).

--Repeat for the second MSM position.

8.7.14 and 8.7.15 The order should be as follows:

--Take krypton lamp exposures at the first MSM setting, building up to the highest safe count rate slit. *Take a longer than average krypton exposure at the p5 setting in order to get a decent flat field--try to get at least 100 cts/low res pixel.*

--Take the Pt lamp exposure through that same slit (unless the ND is prohibitively high or the slit is wider than 0.2 arcseconds--in those cases, use the best count rate 2-pixel slit for mode 1.2).

--Repeat (but with the normal 5 minute exposure times) for the second and third MSM positions.

8.7.16-8.7.19 Will have been done during the echelle blaze testing above.

8.7.20 New step. We should in addition check the count rate for those camera mode-filter combinations for which predicted Pt lamp rates are safe at 1 mA. These are expected to be:

--mode 1.6	aperture 10	1 mA	!!!
--mode 1.6f	aperture 2 (Lyman Alpha)	1 mA	!!!
--mode 1.6f	aperture 3 (quartz)	1 mA	!!!
--mode 1.6f	aperture 7 (SrF2)	1 mA	!!!

Science team: Before taking these exposures, generate a new estimate of the camera mode count rates with the various filters, based on the brightness observed at 1 mA in mode 1.1. The estimate need not be precise, as long as it is conservative and gives results comfortably below the safe count rate limits for the MAMA.

The lamp must be turned on with the CIM out of the beam for 1 mA exposures!! Use the "safe Pt lamp" PSTOL to automatically perform the CIM motions in the proper sequence with respect to lamp turnon.

8.8 Band 1 Image Quality Over Field of View

Because the external illumination system can only cover a small field (< than the 6" x 6" arcsecond size of the slit called for by the procedure for this test), we will need to switch to using the IM Pt lamp.

We will use a combination of "edge acuity" tests, as the procedure calls for (which can only be done at very low per-pixel count rates) and narrow slit imaging tests using a 2-pixel cross-disperser slit at off-nominal slit wheel rotations. The latter exposures can be at significant per pixel count rates and can thus be quite brief.

--image slit 65 at nominal slit wheel rotation, and at +/-0.65 degrees and +/-1.30 degrees from the nominal slit wheel rotation.

Note: these off-nominal slit wheel rotations will bring adjacent slits near but not into the MAMA field of view; the adjacent slits are slit 63 (0.20" x 0.05"; ND 1.0) and slit 57 (24.7" x 24.7"; ND 5).

Assuming Section 8.7 verified safe camera mode/large aperture operation with the IM lamp at 1 mA, carry out edge acuity tests using clear aperture 1 (24.7" x 24.7"), as originally planned.

--take an exposure with the aperture well-centered so that all 4 edges are visible on the detector.

--take exposures with the MSM tilted by +/-0.07 degrees in elevation from nominal centering, in order to put the top and bottom edges approximately 150 pixels from the edge of the detector.

8.1 Band 1 Optical Throughput (Kr) - Final Recheck

Repeat Section 8.1 in selected modes to determine whether any decline in STIS throughput occurred over the course of the test.

NITROGEN POST-TEST

8.10 MAMA Valid Event/Total Event Ratio in Nitrogen

After, backfilling the chamber with N2, take a krypton IM lamp exposure as in step 8.7.6 (mode 1.1), for comparison of MAMA event ratios vs. vacuum data.