Automatic and GO Wavecals, for CCD and MAMA Spectroscopic Observations

Stefi A. Baum
February 2, 1997

ABSTRACT
In this report we describe the implementation of automatic and GO wavecals for CCD and MAMA spectroscopic science. Each time the Mode Select Mechanism (grating wheel) is moved to select a new optical element or tilt a grating, the resultant spectrum is projected onto the detector with an error (lack of repeatability) of ~2-6 pixels. In addition, thermal changes in STIS may cause flexure in the optical bench which may cause the projection of the spectrum onto the detector to slowly drift over the course of time. To correct for the spectral zeropoint uncertainty and drift, the ground system will automatically insert short wavecal (line lamp) observations into a series of external observations using a dispersive optical element. The calstis pipeline will process the wavecals along with the science data in order to correct for zeropoint shifts. In addition GOs can insert additional wavecal exposures into their observations if they require particularly high wavelength accuracy.

1. Why are automatic wavecals taken?
Each time the Mode Select Mechanism (MSM or grating wheel) is moved to select a new optical element or tilt a grating, the resultant spectrum is projected onto the detector with an error (lack of repeatability) of ~2-6 pixels. In addition, thermal changes in STIS may cause flexure in the optical bench which may cause the projection of the spectrum onto the detector to slowly drift over the course of time. The expected timescales for such thermal drifts are of the order of 40 - 60 minutes, and will be measuring during a Servicing Mission Orbital Verification test in the spring of 1997.

If an internal calibration lamp exposure (wavecal) is taken near in time to the science exposures and without moving the MSM between the wavecal and the science exposure, then that wavecal exposure can be used, in post-observation data processing, to calibrate the zero point of the wavelength (dispersion) and spatial (cross dispersion) axes in the spectroscopic science data. For STIS, these science-associated wavecal exposures will be automatically taken for the observer. This assures high quality data for the observer and for the HST archive. The wavecal exposures are processed with the science data in the cal-
5. How are automatic wavecals generated?

6. What is an automatic wavecal?

4. Can automatic wavecals be turned off?

3. Wavenumbers are taken with imaging observations (i.e. when the optical element is a mirror)

2. When is an automatic wavecal taken?
peakuup accuracy) so there should be no need for concern, special construction of exposure sequences or additional peakups unless extremely high accuracy is needed.

To determine the auto-wavecal exposure setup, the ground system first selects the appropriate autowavecal table for the science observation's GRATING. The ground system must then select the appropriate row of the wavecal table for the automatic wavecal. The following set of sequential steps are used to select the proper table row for a science observation (if a match is found stop, if no match is found continue to the next step, if no match is found after passing through 1,2,3 and 4, do not schedule an automatic wavecal for the science observation):

1. Search for the lamp=HITM entry with the science observation's GRATING, APERTURE, and CENWAVE.

2. Search for the lamp=LINE (or CIM) entry with the science observation's GRATING, APERTURE, and CENWAVE.

3. If the science observation uses APERTURE=50 CCD, search for the lamp=HITM entry with default=DEF and the science observation's GRATING and CENWAVE.

4. Search for the lamp=LINE (or CIM) and default=DEF entry with the science observation's GRATING and CENWAVE.

**Table 1: Required table columns for automatic wavecal tables**

<table>
<thead>
<tr>
<th>grating</th>
<th>cenwave</th>
<th>aperture</th>
<th>lamp</th>
<th>lampset</th>
<th>def</th>
<th>exptime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>HITM or LINE</td>
<td>1 or 10</td>
<td>DEF or blank</td>
<td>(in seconds)</td>
</tr>
</tbody>
</table>

CCD wavecals should be taken with GAIN=4 and as single exposures (i.e., CRSPLIT=NO). MAMA exposures are taken as single ACCUM mode exposures.

6. **How do GOs insert additional wavecals?**

GOs can insert wavecals exposures by specifying an exposure with TARGET=WAVE. The GO specifies the CONFIG, APERTURE, GRATING and CENWAVE as well as the exposure time for the GO wavecal exposure. The basic parameters of the wavecal exposure, excluding exposure time (GRATING, CENWAVE, APERTURE, LAMP, LAMPSET) are selected from the appropriate row of the autowavecal table, according to the same rules as used to generate automatic wavecals for science exposures. The only user tunable parameter on GO wavecals is the exposure time, which should generate an error message if specified to be greater than 5 minutes. If EXPTIME=DEF, then the default exposure time from the automatic wavecal table will be used. The insertion of GO wavecal exposures has no affect on the automatic wavecals, which are taken as if no additional wavecals were inserted. The GO inserted wavecals will be processed through the pipeline independently.
Invert CM

Turn desired lamp on to desired setting, wait 1 second.

Remove CM

Position Braking and Arresting wheel to desired configuration.

See above.

Extraneous shutter will be closed. (For a series of internal, the shutter will be closed before the start of the first internal and not reopened until the next external alfumens.)

Lamps should be followed. All lamps must be off at the start of this sequence.

Wavelength of the following sequence for MAMA wavecals: which employs the LINE (in MAMA wavecals) is wavecals. However, for T=AMP=LINE autoimmune/GO wavecals, as with the MAMA autoimmune/GO wavecals, the following sequence is used when the LINE lamps are turned on.

The 3.8 nm wavecals is used in those cases where the 10 nm wavecals causes an extra delay. The 3.8 nm wavecals is used where the 10 nm wavecals causes an extra delay.

The external shutter and operational usage of the Line Lamps

Upgrade the MAMA autoimmune wavecals.

The special rules for writing lamp exposures.

of the science data are isolated lamp exposures.
• Perform local rate check.
• Perform exposure
• Turn lamp off.

8. Wavecal Tables

The CCD and MAMA auto/go wavecal tables\textsuperscript{1} driving the implementation and the associated documentation describing their creation are each maintained on the STIS WWW site under the calibration information button. The exposures times actually implemented will typically be rounded up to the nearest second, from those given in the tables.

Acknowledgments

Numerous technical discussions with George Hartig, MaryBeth Kaiser, Randy Kimble, Steve Kraemer, Don Lindler, Kailash Sahu, Vicki Balzano and William Sears are gratefully acknowledged and we gratefully acknowledge the receipt of the launch versions of the automatic wavecal tables and the software to maintain them from Don Lindler working with the STIS IDT.

\textsuperscript{1}We note that the auto-wavecals tables are in error if either of the following two easily identifiable conditions are found: (1) there is more than one entry in an autowavecal table for a given GRATING, CENWAVE, APERTURE, LAMP and LAMPSET combination, (2) there is more than one GRATING, CENWAVE, LAMP entry in the table with DEFAULT=def.