EUVE GUEST OBSERVER HANDBOOK ADDENDUM FOR 1997

The information in this addendum adds to or supersedes information in the 1995 edition of the *The EUVE Guest Observer Handbook* for the period starting with the release of NASA Research Announcement # 96-OSS-05. In the case of any conflict, information and wording of the current UCB/EUVE Call for Observing Proposals take precedence over that in the *Handbook* and its addenda.

The first section describes important changes in the mode of operation of the EUVE satellite. More specific points about how the change may impact proposals for EUVE science are covered in the sections relating to chapters 3 and 4. Other changes noted in this document, and not having to do with WSZ mode operations, should be self-explanatory. Please send any questions to:

egoinfo.cea.berkeley.edu

A1.1 EUVE Operating in WSZ Mode

In past observing cycles, detector event positions have been transmitted in X,Y format. The detector coordinates of each event were calculated from the coincident wedge (W), strip (S) and zigzag (Z) pulse heights produced by the MCP detector[1] before being put into the telemetry stream. However, the satellite can also transmit the raw W, S, and Z pulse heights for conversion to X,Y in later processing. Effective March 1, 1995, the default observing mode of EUVE was switched to WSZ mode to take advantage of a potential for increasing signal-to-noise in EUVE spectra.

"WSZ" transmission mode preserves additional information on the pulse height of each event, while providing equivalent event position data. The pulse heights can be used to distinguish photon events from those caused by energetic charged particles, and thus provides a mechanism for filtering out this part of the detector background. Proposers can find results of a study on the effects of pulse height filtering on a white dwarf observation in the EUVE Electronic News, vol 5, no 2b, 3/1/95 (*WSZnews*), at the URL:

http://www.cea.berkeley.edu/~science/html/sci_archive_pubs_pubs.html

[1] The operation of the EUVE microchannel plate (MCP) detectors and their electronics is described briefly in § 2.2.4 of the *The EUVE Guest Observer Handbook*.

Effect on telemetry transmission

The satellite can transmit fewer events per frame in WSZ mode. This is not usually a problem for the DS/S instruments, whose count rates are normally low, but it would occasionally affect the Scanners' throughputs. To counteract this effect, the tin filter quadrants on Scanner C , which often have the highest count rates, have been "blanked." This effectively raises the number of event slots available to the other filter quadrants in each frame of telemetry.

Scanner C tin anode blanking means that proposers who wish to use these quadrants for pointed observations must indicate their use as a special requirement of the observation on their Target Summary Form. Otherwise, the change to WSZ mode should have no significant impact on source throughputs for any target except the moon. Observations of the moon require switching the satellite back to X,Y mode.

What WSZ Mode Means for Deep Survey/Spectrometer Proposals

The change to WSZ mode may have an impact on proposal and observation planning. It is possible that the backgrounds of some spectral features, continua, and point source detections can be significantly decreased by filtering events based on pulse height. Pulse height filtering effectively eliminates the background from particle events. The total backgrounds of test spectra were reduced by 8 – 50%, depending on detector thresholds, and the width of the pulse height filters used. These gains were made at the expense of losing 2 – 14% of the source counts, which were also removed because the pulse height distributions overlap. See *WSZnews* for the statistics for each Spectrometer channel. See example A1.1 for a practical example on applying the changes.

A1.2 Changes in Observations Planning

The changes to Chapter 3 of the *Handbook* are presented in the order of their section numbers. The most notable change in EUVE operations is, that EUVE is no longer collecting daytime data, except for periodic engineering tests. Day-time date was eliminated to help streamline spacecraft operations and planning.

A1.2.1 Electronic Resources for Proposers

Please note the following changes in § 3.2:

◇ The address of the CEA/EUVE anonymous *ftp* site is now:

`ftp.cea.berkeley.edu  or  128.32.154.12`

◇ Call for Proposals materials in the ftp site will be in the directory:

`/pub/nra97/`

◇ The following URL's should be used to access WWW resources:

- CEA HomePage on the World Wide Web:

  `http://www.cea.berkeley.edu`

- EUVE Science Page:

  `http://www.cea.berkeley.edu/~science`

  The utilities for calculating ISM absorption and target visibility are still accessed from this page.

- All Call for Proposals materials will be made available from a WWW page in the CEA Web site:

  `http://www.cea.berkeley.edu/nra97`

- Access to EUVE Web pages through *telnet* port running the *lynx* Web client:

  `no longer supported by CEA`

◇ Instrument data files listed in are now in:

`/pub/nra97/data/`

◇ Using the IRAF/EUV software package:

- Current version of the IRAF/EUV software package is **1.7**, and the software may be obtained from the *ftp* site directory:

  `/pub/software/euv1.7/`

- Current version of the EUVE reference data is **1.15**, and may be obtained from the *ftp* site directory:

  `/pub/reference/egodata1.14/`

References to the EUV software package and EUVE reference data elsewhere in the Handbook should be updated as well. Always use the most recently released versions of EUV software and the reference data for preparing proposals.

A1.2.2 Potential for Lower Distributed Background

Because of the switch to WSZ mode, the distributed background estimates in § 3.6.3 may be effectively changed. GO's may be able to use the potential decrease in background to decrease the integration times required for some sources. This might have the advantage of allowing some proposals to have more targets approved. Other proposals may benefit directly from increased signal to noise as an effective increase in sensitivity which improves the scientific justification. The percentage of change in any one observation may be different from the estimates given here, as the particle environment of EUVE's orbit varies with solar activity and other factors. Proposers should still request exposure times that are reasonably certain to produce the desired results.

While the EGO Center now provides all GO's with the raw data files and IRAF software tools for doing pulse height filtering, proposers must bear in mind that this processing IS

NOT done as part of the EGO Center's nominal data reduction. GO's who do not have IRAF installed at their home institution may wish to write their own pulse-height filtering software, or visit the EGO Center to perform this reduction step.

To assist proposers in planning observations based on the lower backgrounds, we provide some variations on the example calculations of exposure times given in the GO handbook. Example A1.1 is based on a specific choice of pulse height filters: 10,000 – 30,000 for SW, 10,000 – 25,000 for MW, and 12,500 – 42,000 for LW. Each pulse height is a number in engineering units from 1 to 65k, the result of a simple algebraic conversion of the W, S, and Z pulse heights transmitted. These filters are estimated to have the following effects on the Spectrometer channel background and source count rates:

$$\begin{array}{llll} \mathcal{B}_{sw} \rightarrow 74\% \times 5.4{\times}10^{-4} & = & 4.0{\times}10^{-4} & \text{counts/second/Å} \\ \mathrm{S}_{sw} \rightarrow 92\% \times \mathrm{S} & & & \text{counts} \\ & & & \\ \mathcal{B}_{mw} \rightarrow 64\% \times 2.9{\times}10^{-4} & = & 2.1{\times}10^{-4} & \text{counts/second/Å} \\ \mathrm{S}_{mw} \rightarrow 97\% \times \mathrm{S} & & & \text{counts} \\ & & & \\ \mathcal{B}_{lw} \rightarrow 74\% \times 1.7{\times}10^{-4} & = & 1.2{\times}10^{-4} & \text{counts/second/Å} \\ \mathrm{S}_{lw} \rightarrow 98\% \times \mathrm{S} & & & \text{counts} \end{array}$$

Where the number of source counts, S, is calculated from equation 3-1 for emission lines or 3-2 for continuum sources. These reductions apply to the distributed background only. Airglow counts are expected to be reduced by the same fraction as the source counts.

Example A1.1 : Late star emission S/σ

This example begins in § 3.6.3 of the *Handbook*, with the determination of the estimated background for an emission line at 171.06 Å. If the background in the SW detector is reduced by 26%, the approximate decrease produced by using the 10k-30k pulse height filter, the short wavelength estimate for the background under the line becomes:

$$\mathrm{B}_{SW} = 4.0{\times}10^{-4} \times .5 \times 40,000 = 8 \text{ counts},$$

where we assume a 40 ksec observation, as in Chapter 3. The source flux would also be reduced by 8% in the filtering process. This produces 141 instead of 153 counts, and a standard deviation for the line of:

$$\sigma_{SW}(171.06) \ = \sqrt{141 + 8 \times (1.1)} = 12 \text{ counts},$$

where 1.1 is $1/n + 1$ for $n = 10$. The signal-to-noise ratio is:

$$\frac{S}{\sigma_{SW}}(171.06) \ \simeq \frac{141}{12} \ \simeq 11.75,$$

i.e. the decrease in source counts is as significant as the decrease in background for this integration time, and the S/N is nearly the same as the previous value (11.8).

The example for the same line in the MW channel has a 36% decrease in the background and a 3% decrease in source counts. If we also assume that the integration time is longer, say 60 ksec, this produces:

$$\frac{S}{\sigma_{MW}}(171.06) \simeq \frac{352}{\sqrt{352 + 13 \times (1.1)}} \simeq 18.4$$

For this exposure time the elimination of the particle background would probably increase the S/N from about 16 to 18.

Continuing the same example, one uses equation 3-11 to calculate the desired exposure time for the 222 Å feature from the new MW source and background rates, Assuming the bin size to be $\Delta\lambda$, which in the MW is 1 Å, and a required S/N of 5:

$$\mathcal{T} = 25 \times \left[\frac{1.08{\times}10^{-4} + 2.1{\times}10^{-4}\,(1.1)}{1.166{\times}10^{-8}}\right] = 7.27{\times}10^{5}\,\text{seconds.}$$

This is roughly a 20% decrease in the integration time necessary to obtain the desired S/N, over the previous figure of $9.15{\times}10^5$ seconds.

A1.2.3 Increased Event Timing Accuracy

The timing accuracy of the W,S,Z pulse heights is somewhat greater than that of the calculated X,Y positions given in § 3.8.1. Events telemetered in WSZ mode are time-tagged with an approximate accuracy of ±1 ms, as opposed to ±8 ms in XY mode.

A1.2.4 Longer Response Time for TOO's

Due to the streamlining of payload and platform operations, the expected response time for targets of opportunity (TOOs), as defined in § 3.9 of the *Handbook*, will be on a "best-bet" effort. The actual response time should be less than 24 hours, but this will not be guaranteed. See the announcement in the EUVE electronic news (URL above) vol 5, no 4, 4/18/95 for more details.

A1.3 Changes to Data Products, Software, and Processing

There have been several changes to GO data products and EGO Center data processing of which proposers should be aware. Some are connected to the change to WSZ mode described above.

A1.3.1 Deep Survey Data Provided

It is no longer necessary for GO's to specifically request the Deep Survey image data for their observation, as stated in § 4.3.2. The relevant data products are now delivered as FITS files on the data tape. Events from the Deep Survey (detector 7) are now included in the event telemetry table, and a Deep Survey QPOE file and remapped image are created in the course of EGO Center nominal data processing. The data products are documented in the *EGO Center Data Products Guide*, available from the CEA/EUVE *ftp* site in the directory `/pub/documents/docs1.6/`.

A1.3.2 EGO Center Data Processing and Delivery

Some parts of the EGO Center nominal data processing performed for GO's have changed significantly, due to changes in both the IRAF/EUV software packages and the changes in satellite operations described above. The current version of the IRAF/EUV software is **1.7**.

1. Events are now stored in the FITS table used to store the raw telemetry as either W,S,Z pulse heights (the default), or X,Y location, depending on the operating mode. Previously, the events were always stored in the telemetry table as the X,Y locations. This is the only substantial change in EUVE Spectrometer data products.
2. The standard processing script used to run the event pipeline on GO observations now performs the conversion of W,S,Z to event positions X,Y. QPOE files created by the pipeline have the same attributes as before, and spectral images are created as before.

A1.3.3 IRAF Reduction Tools

The software now supplied to GO's contains two new kinds of alternate pipeline scripts:

1. Scripts for creating IRAF QPOE files with event pulse heights from WSZ format data. GO's can now produce pulse height QPOE files and make pulse height filtered spectral images by applying an attribute filter in a QPOE I/O interface expression[2].
2. Scripts for generating position-remapped Deep Survey QPOE files. The use of these scripts is documented in the *EGO Center Software User's Guide*, version **1.5**. Deep survey event positions are mapped to (RA,Dec).

[2]Use of the QPOE I/O interface is also described in the *EGO Center Software User's Guide*.