SXT CHIEF OBSERVER HANDBOOK

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Preamble

This handbook is designed to help newly trained Chief Observers (and possibly old hands) to carry out SXT Chief Observer duties and observations. It should be read with reference to the Red Book where design and instrument descriptions are explained in detail.

1. General Chief Observer Duties

The Chief Observer is responsible for scientific decisions regarding the use of the telescope and the preparation of appropriate command uploads. Newly acquired data should be checked in order to pinpoint any problems with the instrument or any deviations from the previous day's planned operations. The Chief Observer should also carry out routine operations, such as CCD bakeouts and dark current calibration runs. The former of these two is usually done every couple of months or so, depending on quality of the data, with the latter once a week, normally on Wednesday at KSC Pass 4. These operations are best understood by examining previous tables used for these purposes. During a campaign program the Chief Observer ensures that the SXT is in the appropriate mode, making the appropriate observations and maintains regular contact with the campaign collaborators.

1.1 First_light

Each day first task should be to run *first_light* from within IDL. This program produces a GOES plot of the previous day's activity together with KSC contact times for the current day. The GOES plot includes SAA passes and spacecraft night times together with an overlay of the times of Yohkoh PFI and FFI frames. The *first_light* program also runs *pr_evn* for some software specified period of the previous day, giving times for which Yohkoh data are available (here an event means a change between QUIET and FLARE modes or where there is a data gap). The number of available images is printed out together with a list of FFI's (noting where there are gaps in the data) and the number of unique pointings. These pointings are shown superimposed on SXT images which also contain a NOAA grid with active regions identified.

The *first_light* procedure gives a lot of useful information in addition to that noted in the preceding paragraph. The routine creates SFD (SXT FFI decompressed) and SPD (SXT PFI decompressed) images and stores these in the directory /yd3/reformat. The information on the PFI, FFI and SFD files are stored in the IDL structures, pindex, findex and sindex, respectively with the data being contained in pdata, fdata and sdata, respectively. The first and last times contained in the index structure is displayed (the program places a call to *fmt_timer*). The comment lines of the last upload table are shown and its stored address given. (Be warned that this does not always provide the correct information; I think this has something to do with staying logged on continuously with multiple calls to *first_light*. Instructions on how to check the table in the spacecraft are given later.) In addition, a statement of the thin Al flux detected and a comment on the solar activity is also displayed. The number of unique pointings is given along with corresponding heliocentric locations, mispoint information, any SAA passages and any spacecraft night time encountered.

The *first_light* program also overlays the projection of the current Ulysses spacecraft position on the SFD image, denoted 'U', together with the footpoint of the field line 'connnecting' Ulysses to the solar surface, denoted 'F'; see *helio_foot* by Hugh Hudson for details. This version of *first_light* also obtains the last available ground-based observatory images of the following types: Kitt Peak Magnetogram, Kitt Peak He 10830, Big Bear Hα and Nobeyama Radioheliograph. These are displayed together with the last SFD image in the same window. This image, in principle, allows the Chief Observer to examine the latest solar observations over a range of wavelengths and to make SXT observation decisions based on this data.

There is also a keyword option, */summ*, which is available with the *first_light* program which produces an excellent summary of the latest available SXT and ground-based data. In addition this summary displays the GOES plots, solar grid, PFI pointing information and the SXT Observing Region. In this version of *first_light* the ground-based data included is a Kitt Peak Magnetogram and He 10830 image, a BBSO Hα and white light image and a Nobeyama Radioheliograph image. The details of the GOES events, the NOAA active region reports and the Yohkoh event log are returned to the screen.

1.2 Operations

The program *contacts* yields the KSC contacts for specified time period and should be run every week to obtain the times available for command uploads in the coming week. The contact times should be compared and checked with the weekly visible diagram provided by the SSOC tohbans. There are normally 5 passes per day; OP's are normally uploaded at Pass 1 unless special observations are required. There are normally no uploads at the last pass of the day, normally Pass 5, since any errors in uploaded tables cannot be corrected until the next day. The actual passes used are determined by the SSOC tohbans and the weekly visible diagram is FAXed to D-toh. Once the contacts have been decided the Chief Observer prepares the SXT Table list.

The Chief Observer should also check the CCD dark current and stray light behaviour using *.run plot_sld* and *.run plot_sls*. The first of these shows the build up of dark current across the CCD since the entrance filter failure, while the other plots the SXT scattered light engineering data (this is obtained by the dark frames entered in position 2-1 and 2-2 of FFI Table 2). These routines are described in Appendix 1.

Each Monday morning at the weekly operations meeting the Chief Observer presents a prepared report based on the previous week's operations and observations together with a Table Plan detailing the plans for SXT observations in the coming week.

2. General Observing Notes

Routine observing with SXT is a relatively simple task in terms of making the upload tables. However, special operations, such as campaigns or eclipses, normally require much more work and more careful planning and checking of the table uploads. Some general points to bear in mind are discussed here.

ARS1

This is the standard mode of operation. A morning patrol image is taken and the brightest active region chosen as the PFI target. This is superseded by the triggering of a flare flag. Normal observing region is 2x2, or 128x128 pixels. See the program *ars_show* for a simulation of this SXT observation mode.

ARS2

If ARS2 is chosen then the location of the PFI observing region is fixed by the Chief Observer. This is different from fixed pointing in that the centre of the PFI is continuously updated to the brightest pixel.

Consequently, there will be some movement of the PFI with each patrol image.

Fixed Pointing

Many special observations require fixed pointing at a particular location on the solar disk. This operation is carried out by use of the OR Table (see below). In order to choose the correct location the one should use the program *sxt_obs_coord*. This is described in section 5, but basically it allows one to obtain the coordinates of the chosen target at the time of the observation from an earlier SXT image. The location of the centre of the OR is given in CCD coordinates as well as heliographic coordinates. It is the CCD coordinates which are entered in the OR Table but in the information to the tohbans, the heliographic coordinates should be given. The number of the OR table used for the fixed pointing should be entered in the appropriate place in the PFI Table. Fixed pointing also requires the disabling of the ARS mode. This is done in the COMMON Table.

ART

The ART function is a particularly useful mode of operation when offpointing is planned. The observing region is chosen by the Chief Observer and the coordinates are inserted in one of OBN #4-7 in the ROI Table. The PFI frames will then target those coordinates and remain there until a new table is uploaded. The ART function allows the OR to be tracked even when the spacecraft is offpointed.

When using ART it is important to ensure that the following is done; ART should be ENABLED and IRU selected in the COMMON Table and an ART initialise (DC) command must be inserted into the Pass sheets by the SSOC tohbans.

Offpoints

Occasionally, it is necessary and deirable to offpoint the spacecraft, say to look at polar coronal holes or to obtain images of the extended corona. Offpoints can be inserted manually by the KSC tohbans but it is preferable to edit the OP command table. This is in the hands of the SSOC tohbans, so if an offpoint is required this information should be conveyed to the SSOC tohbans with clear instructions for them to follow. Normal offpoints, for which an OG exists, include a 4 arcmin North offpoint, an 8 and 16 arcmin south offpoint, an 8 arcmin west offpoint, an 8 arcmin east offpoint, a 4 arcmin NE offpoint, an 8 arcmin SE and an 8 arcmin SW offpoint. These are absolute pointings from disk centre, so if you follow an 8 arcmin south offpoint with an 8 arcmin east offpoint the spacecraft will point 8 arcmin to the east. It is possible to do fixed pointing while carrying out an offpoint. If this is required then the appropriate number of CCD pixels should be added to or subtracted from the target coordinates to allow for the new 'centre' of the field-of-view unless the ART function is selected (see above).

Filters

The control of the SXT filters is important since this provides the diagnostic capability of the SXT. The choice of filters and combinations of filters depends entirely on the sort of observations which are to be made. The filters can be controlled for each PFI or FFI table entry. Things to note are the problems with stray light, particularly in Al.1 (see below).

Exposure control

The control of the exposure times is also very important and should be carefully tailored to the observations required. If AEC is enabled, the PFI exposures are adjusted automatically for each table entry. The maximum allowable exposure can be fixed by the appropriate entry in the AECHO slot in the COMMON table. Fixed exposures are obtained by disabling AEC in the PFI Tables.

Dark Frames

Generally, one should always use the Dagwood sandwich filter (AlMg) for the taking of dark frames. The filter itself makes no difference with the shutter closed (dark) but the AlMg has been shown to be sufficiently good in terms of reducing the small amount of stray light which gets around the shutter. For special observations, such as in an X-ray bright point campaign, it is sometimes useful to take PFI dark frames. This is really only useful if one requires fixed exposure, fixed pointing images. In this case, the dark frames can be matched in exposure to the PFIs and can thus be used to improve statistics. One should be careful to note that under ARS2 observations there will be some movement of the PFI with each patrol image and under these conditions PFI dark frames are not useful enough to merit the interruption of the PFI observations. The standard FFI dark frames are quite good except perhaps for very faint features.

Stray light

The SXT suffers from a problem of stray light entering the telescope and creating a general background on the CCD. This stray light gets into the telescope because of the damage to the entrance filter and reaches the CCD around the filters. There are also a number of pinholes in the thin Aluminum (Al.1) filter through which the stray light impinges the CCD directly. The effects of stray light on SXT images can be subtracted reeasonably well but the subtraction of the pinhole is not perfect. The effects of stray light on the SXT images can be seen in the *calibration* directory of *show_pix*.

Terminators

The terminator images (1-1 in the FFI QT/H table) are used to correct SXT images for straylight and for background subtraction. The terminators are taken immediately after the morning interval is over (this is set in the COMMON Table and is normally set to 4 DP units or 2^m8^s). It is important to build up the terminator database, particularly for different filters and different spacecraft pointings. A program has been initiated which is designed specifically for this purpose. The procedure *pr_sxt_term* prints out a table showing the number of terminators in the database as a function of pointing and filter, for the dates chosen. The Chief Observer should use this to facilitate the choice of terminator image required. [Please note that an analysis of terminator images is currently underway (11/3/94) and modifications to the *pr_sxt_term* program will be made].

Use of parts of CCD

One technique which is useful if one requires faster cadence of FFI images of a given resolution is to use only a portion of the CCD. Using half of the CCD, for instance, effectively doubles the FFI cadence. This can be particularly useful when making full resolution coronal hole observations. To choose a part of the CCD is a simple matter of entering the correct CCD coordinates (starting row and OR width) in the second page of the appropriate FFI table (reached by PF11).

3. SXT Table Loading

3.1 Computer instructions

The computer used for table uploads may be accessed in two ways depending on the state it is in when you get to it. If it says READY you should type *LOGON TSS SR0001* and proceed from the password stage of the third step below. If you have to switch the computer on then start at the first step below.

:- click on top box on 1st screen

:- click on SSOC#1 on 2nd screen, then wait

:- userid *SR0001* passwd *ahonosxt*

:- type *profile prefix (ql)* - this produces a quick look directory and is apparently unnecessary.

:- type *ex sxtspt* - this runs table environment and brings up the main menu

• Note that one should use <ENTER> and not <CR>; <ENTER> is the bottom right key on the centre of thekeyboard.

3.1.1 Basic Procedures

• From main menu work your way through 1-3 (we never use option 4 and seldom use 3):

:- A selection of 1 produces the TABLE DATA DISPLAY

:- type 1 in 1st box at top (don't use 2nd box) ; ENTRY/EXPOSURE COMMENT

:- use tab key to shift between boxes

:- usually use upload file option (5) - (don't use options 3 or 4 much)

:- press <ENTER> when happy with screen

:- use update to correct or check table

:- use 1 to create file ; PF11 will cancel operation here

:- enter table number ; table number under which new table is to be stored

:- again use tabs to move between boxes

:- don't worry about EXPOSURE LEVEL TABLE

:- modify tables as required (use PF7 and PF8; see below)

• <u>ENTRY TABLE</u>

In COMMENT AREA put:

:- date of table in UT

:- summary of main observation plan

:- date of upload in JST

:- initials of Chief Observer

- ROI (Region of Interest) Table

The ROI table is used for selecting the size and centre position of the PFIs. There are four ARS and four ART rows. The standard ARS observations normally use OBN 0 (first row) and OBN 4 when doing ART observations. The location of the PFI is entered in CCD coordinates and can be determined using *sxt_obs_coord* (see section 5).

- PFI Tables $(0-3)$; PF10 and PF11 operate here, see below

There are four PFI tables, with numbers 1 and 2 being used for normal quiet mode operations, number 3 for flare mode operations and number 0 for special operations. Each PFI table is a sequence table with five loops (see the Red Book for a description of how these loops work). Careful planning of the PFI table entries allows the full versatility of the SXT observation modes to be realised. These tables control;

:- the exposure times, which can be fixed or varied automatically by disabling or enabling the automatic exposure control (AEC), see recommended exposures in Appendix 2.

:- the choice of filters and filter sequences (2/1 is Al.1, 3/1 is Dagwood and 5/1 is Al1.2)

:- the PFI resolution

:- the number of any particular PFI image or sequence of images via the loop counter controls.

:- the Observing Region (OR) used, via reference to ROI Table.

It is possible to use the PFI tables in complicated ways. For example, once can switch between two different ORs and by using the loop counters efficiently the time spent on each OR can be regulated.

- FFI Tables $(0-3)$; PF10 and PF11 operate here, see below

There are four FFI tables. FFI #1 is normally reserved for QT/M observations and FFI #2 is for QT/H mode. FFI #0 and #3 are used primarily for special observations, e.g. dark calibration. The tables control the full frame observations via filter selection, choice of resolution and exposure control, much in the same way as the PFI tables.

The FFI tables are also used for the taking of terminator images (position 1-1 in FFI #2) and can control whether the shutter is open or closed by declaring if a normal or dark frame is to be taken.

- <u>COMMON Table</u>

The COMMON table is used to determine the general mode of SXT operation. The maximum allowed exposure (AECHO), the taking of morning patrol images can be disabled, the ARS mode is controlled by selecting ARS1 or ARS2 or by disabling ARS altogether if fixed pointing is required. One can also define the length of the morning interval which is normally defined as 4 DPE units or ~128s. Usually, only the functions mentioned here are changed on a regular basis. The others are best left to the more experienced Chief Observers.

- An example of each of these tables can be seen in Figure 1.

- When entering data in the filter columns of PFI or FFI tables, an entry of 7/7 means NOP, i.e. no operation. One should try to get the DPE column as correct as possible.

- When creating a new table from an old table remember to change file name.

- When happy with tables press PF3 to enter UPLOAD FILE UPDATE area. This allows you to overwrite previously stored upload tables. Overwrite the oldest file of the type you have just created, e.g. ARS-1 STD+LONG, DKCAL etc. Again when satisfied with the newly stored file title press PF3 (PF11 aborts the update at this stage).

- Press PF3 again to return to main menu. This time select 2.-GENERATE TCU COMMAND. This will create the necessary commands from your newly created tables. Enter the number of the upload file you have just updated. You are now in a position to generate the command. To do this select 1 (do not use 2) since this generates a command sequence only from those parts of the table which have been changed. [To cancel sending the command to KSC press PF3 before selecting 1].

After acknowledging transmission of command to KSC (with <ENTER>) insert 3 (NAME) to display the commands. This creates a batch job. The job started will have a name like SR0001* where * is one of [0-9,A-Z], make a note of this filename for inclusion in the SXT FAX to the SSOC and KSC tohbans (see below).

Press <ENTER> to clear message. Press PF12 to compare the current file with the upload you have updated. This submits another batch job with name SR0001* which should also be noted and included in the FAX.

- Apply PF3 until you are back in the main menu.

Notes

- In addition to the options discussed above the BASE TABLE also includes:

archive file - stores old tables

template file - stores templates of useful tables

The PF7 and PF8 keys are used to move forward and backwards through the pages, respectively.

The Observing Region (OR) table is used to specify PFI.

Flare and patrol images have same number table - OR-8 - which is used for medium rate observing.

The key above the right-arrow deletes the option box entry.

The PF9 key moves one within the PFI and FFI tables; there are 4 different tables for each.

Only half of the PFI and FFI tables appear on one screen; PF10 and PF11 should be used to toggle between first and second halves.

The TAB key moves one through the 'fields'. Shift and tab together moves one backwards through the 'fields'.

- The PF3 is very important as this saves the table and takes you back through the menus. Do not use until certain of tables.

- When one gets out of the table environment the following apply:

*** prompt requires you to press <ENTER> to continue.

The command *st* lists files containing current and previous tables. This list should normally be limited to 6 files. If this number is exceeded, delete oldest files. To delete files one can go into *pfd* environment (type *pfd 3.8*) and choose delete option with correct filename (see figure). To list files within it pfd choose *inform job status* option. Again PF3 gets one out of *pfd*. An alternative is to type *cancel SR0001# p* on the mainframe command line. Use *logoff* or *of* to quit the session.

4. SXT FAX

The SXT FAX is the main mode of communication between the SXT Chief Observer and the SSOC and KSC tohbans. After the Chief Observer has decided on the day's observations and sent the appropriate table to KSC for upload, a FAX is prepared with all the important information and is then forwarded to the tohbans. The FAX should be clear and concise since not all of the tohbans are fluent in English. The best approach is to follow previous examples. The FAX should contain the correct table ID and the pass number at which it is to be uploaded. A brief description of the planned observations, detailing changes of filter, exposures, fixed pointing locations, etc., and the names of the relevant mainframe files should also be included. The Chief Observer should append a copy of each table changed for that days operations, indicating clearly the changes made.

In the case where there are special or particularly important instructions (e.g. 2 table uploads in one day) the Chief Observer should contact both SSOC and KSC tohbans by phone, in addition to the FAX.

5. Useful IDL Commands

Listed below are several routines that have proved useful for general Chief Observer work. there are of course many more. If more information is required about these routines use *doc_library*.

print, gtab_ffi(nt,nf) - displays SXT FFI table number *nt* and FFI entry table *nf*. There are several *gtab* routines and these can be very useful on occasion.

sxt_obs_coord - allows the determination of the coordinates for fixed pointing. This uses the differential rotation algorithms to determine the location of any user-selected region and any selected time.

sho_data - allows the determination of the average DN count rate in user-selected region or solar feature; useful for choosing exposures.

laser,/portrait - plotting mode

.run plot_temps2 - plots CCD temperature at different test points (uses index structure)

pprint - from within *set_plot,'ps* sends plot to printer without creating save file.

ars_show - this provides an onscreen simulation of how the onboard ARS1 software selects a PFI observing region. The best way to find out about this is to play with the software.

color_copy - copies current (or specified) image to colour copier.

goes_summary - produces summary of GOES events for dates specified.

6. General Notes

Fixed pointing observations are well worth doing when the Sun is quiet.

Morning patrol resets exposure to initial exposure (AEC).

Patrol images are not normally telemetred down but can be captured manually by KSC if required.

Patrol images during SAA can cause pointing problems.

If you require continuous orbits of observations use KSC passes 2 and 4 unless circumstances dictate otherwise.

Change of mode from medium rate to high rate (and vice versa) restarts SXT table.

Day time patrols do not restart tables

If there are major computer problems requiring immediate attention contact Ogawara-sensei (Phone Number: 0423-83-8643 (home); 2609 (office)).

There are telemetry conflicts with the ASCA satellite and the Yohkoh tohbans should confer with the ASCA tohbans to avoid conflicts. Any Yohkoh KSC passes assigned to ASCA should be notified to the Chief Observer. If special operations are required and passes kept then the Chief Observer should inform tohbans well in advance. The best format for this would be at the weekly operations meeting.

Should use fixed pointing when doing CCD bakeouts to avoid ARS jumping to dark spikes.

A.1 CCD Engineering checks - Dark Current and Scattered Light

In this Appendix we give the *doc_library* obtained descriptions of the IDL routines, *plot_sld* and *plot_sls*.

PLOT_SLD

PURPOSE:

To plot the SXT dark current signal after the Nov-92 entrance filter failure.

CALLING SEQUENCE:

.run plot_sld

METHOD:

Dark frame images are taken with the Be x-ray analysis filter. After 17-Nov-92 entrance filter failure, it was noticed that the dark current signal increase dramatically. This routine monitors that increase (which decreased after a few months). A full frame image is taken and broken up into 51 vertical strips (20 columns per strip for FR, 10 for HR, and 5 for QR). The values plotted in the first plot are strip 5 and strip 0. Strip 5 is the area where the increase in the dark signal was seen. Strip 0 is off the area where the sun hits the CCD and is a reference area. The HR images are converted to the equivalent signal for a QR image.

Open /Al.1 Half Dark C 13 78.0 512x512

Open /AlMg Qrtr Dark C 13 78.0 256x256

A full frame image is taken and broken up into 51 vertical strips (20 columns per strip for FR, 10 for HR, and 5 for QR). The values plotted in the first plot are strip 5 and strip 0. Strip 5 is the area where the increase in the dark signal was seen. Strip 0 is off the area where the sun hits the CCD and is a reference area. The HR images are converted to the equivalent signal for a QR image.

Open /Al.1 Half Dark C 13 78.0 512x512

PLOT_SLS

PURPOSE:

To plot the SXT Scattered Light engineering data

CALLING SEQUENCE:

.run plot_sls

METHOD:

Dark frame images are taken with the narrow band analysis filters. Since the leak after 17-Nov-92 entrance filter was intense enough to show signal at the CCD even with the CCD closed, we use this data to monitor the size of the aperature in the entrance filter. The values plotted are the average signal for the whole FFI image. The HR images are converted to the equivalent signal for a QR image. The 70 DN "fat zero/dark current" of the QR images is still in the values which are plotted.

There are two sets of values because of the difference in the stopped position of the shutter blade. Two of the four positions allow more light to leak around the blade.

NaBan/Open Half Dark C 2 1.0 512x512

NaBan/Open Qrtr Dark C 2 1.0 256x256