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**SOT, A RAPID PROTOTYPE USING TAE WINDOWS**

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## SOT, A RAPID PROTOTYPE USING TAE WINDOWS

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The window interface extension is a new feature of TAE. We are using this feature to prototype a Space Station payload interface in order to demonstrate and assess the benefits of using windows on a bit mapped display. We also want to convey the concept of Telescience, the control and operation of Space Station payloads from sites remote from NASA. This effort is part of a Goddard Space Flight Center (GSFC) research topic (RTOP) directed at identifying and evaluating user interface technologies applicable to system design in the Space Station era.

The prototype version of the TAE with windows operates on a DEC VAXstation 100. This workstation has a high resolution 19" bit mapped display, a keyboard and a three-button mouse. The VAXstation 100 is not a stand-alone workstation, but is controlled by software executing on a VAX/8600. Function calls can be made to this software to create windows and mouse sensitive regions on the VAXstation screen.

When TAE is executed, it uses these features to create it's own (TAE) window to display standard menu, tutor and help screens plus a status window which typically appears at the top of the screen (see figure 1). With the exception of being displayed in a window, the contents of the TAE window are no different from what is normally seen on a standard video terminal. The status window allows the end user to bring down TAE, bring the current window to the top of the screen, store and recall windows and send an attention signal to all windows.

TAE also provides the user and the application programmer with access to the windowing features via C language functions and TAE commands. For example, to create a window, a programmer may use the TAE command WINDOW-CREATE or the C language function `w_create`. Other C language functions can be called to manipulate windows, for example, moving and storing windows for later recall. Another service is the creation of mouse sensitive rectangles from a C program. With them, an application programmer can make 'mouseable' buttons which can report the results of a click back to the program.

Telescience will allow a user to control instruments associated with the payload from his or her home institution. The payload may be attached to the Space Station itself, or located on a co-orbiting or polar-orbiting platform. The user employs a workstation to send commands to and receive data from the payload. For the most part, this will occur without problems and the underlying NASA systems will be transparent to the user. However, there will be many payloads attached to the platform, each contending for a limited

number of resources and the ability to impact the environment of the platform. When conflicts arise for these resources and abilities, a user must interact with the Telescience system in order to them.

In order to demonstrate windowing and Telescience concepts, a payload was chosen for which a short scenario was developed. The payload we used as the model for the prototype is the Solar Optical Telescope (SOT). The SOT contains a primary mirror which can be moved to scan the entire solar disk. It can be directed to move to one of 254 predetermined regions on the sun and then to move in fine adjustments of a few arc-seconds. The light from the mirror is directed to a charged coupled display (CCD) imaging device and to one of three instruments. The instrument the scenario deals with is a scanning spectrograph known as the slitjaw. The slitjaw may be positioned by rotating the whole instrument assembly; it is desirable to do so when the slitjaw is not perpendicular to the feature being studied.

The scenario starts out with an end user sitting in front of the VAXstation 100. Adjacent to the VAXstation is an image analysis terminal used to display the CCD images. This analysis terminal is controlled via the VAXstation and is used in the target acquisition process as well as for the display of data. Prior to this session, the end user has already scheduled with NASA a block of time in which the user may perform real time (or 'near' real time) 'command and control of the SOT.

The prototype scenario is shown in figures 1 through 7. Figure 1 shows the VAXstation screen when the user first logs on to TAE. The root menu is displayed in the TAE main window. From this menu, the user chooses item number one to display a window containing status which is continually updated to reflect the current state of the SOT. The user also chooses item number two to display a list of experiments in another window. Figure 2 depicts a tutor for the date of this list just after the run command has been entered.

Again from the main menu the user begins target acquisition by selecting item number three to show the target acquisition menu (figure 3). By choosing item one, the end user is tutored for the region number. The user supplies the number experiment B seen in the list window. By 'running' the tutor, a command is sent to the SOT to move the mirror to the desired location. A CCD image is then sent down from the SOT and displayed on the adjacent image analysis terminal. The user then positions the phenomena of interest, a filament, in the center of the mirror's field of view by selecting item two from the target acquisition menu and supplying the X and Y coordinates of the resulting tutor. Again, running the tutor causes a command to be sent to the payload. For each action performed by the user, the status window is updated to reflect the position of the mirror.

On looking at the image analysis terminal, the user notes that the filament is not aligned perpendicularly with the overlaying image of the slitjaw. From item three of the target acquisition menu, the user attempts to rotate the slitjaw by supplying the

subsequent tutor with an angle. The underlying Telescience system informs the user via a dialogue box (figure 4) that torque on the platform will result from the rotation and the user has not scheduled an event which can create torque. The dialogue box presents the user with the choice of either taking the data from the slitjaw in its current position or finding the next time when the rotation may be performed. The user must respond to the box and does so by moving the mouse pointer over the 'Find Next' region and clicking the mouse button. The Telescience system will then inform the user at a later time when the rotation may be scheduled.

While the NASA system is processing the above request, the end user backs up to the main menu from which the user chooses item four. The user is in the process of filling in the resulting instrument configuration tutor when the system displays another dialogue box asking the user to select a time when the roll may be performed. The user may ignore the box for a while to complete the tutor or, as is the case here, respond immediately by clicking a mouse button with the pointer over the desired time region.

Figure 6 shows the screen at a slightly later time with the system informing the user that the rotation may now be performed. The user clicks on "OK", finishes with the instrument configuration tutor and returns to the rotate tutor. This time the execution of the rotate proc is successful and the resulting payload command positions the slitjaw correctly over the filament. The end user may now proceed to analyze the resulting data being collected by the slitjaw.

One of the main benefits of using windows is the way that multiple views into a system may be displayed on the screen simultaneously. For example, once the status window is displayed the end user can tell the well being and configuration of the SOT on a continual basis, without having to ask for the information. Another benefit is that messages can be displayed so as not to interrupt the current activity. The end user may respond to a message at leisure. Of course some messages must interrupt the user as was done when the slitjaw rotation could not be performed. This is done only when the system cannot proceed without information from the end user.

The VAXstation 100 TAE window extensions are themselves a prototype of a much more expansive system which will be designed in the near future. The SOT payload operations prototype will be used to help direct this effort. One exciting extension is the use of graphical interaction techniques, for example, performing target acquisition by tying the movements of the mouse to cross hairs over the CCD image. A click of a mouse button will set up a TAE proc to move to that position - it's another way of filling in a tutor screen! Some of our latest prototyping efforts at Goddard show such an interface but these efforts do not use TAE. We hope in the future to mesh these interface techniques with TAE to produce a highly interactive and easy to use interface.

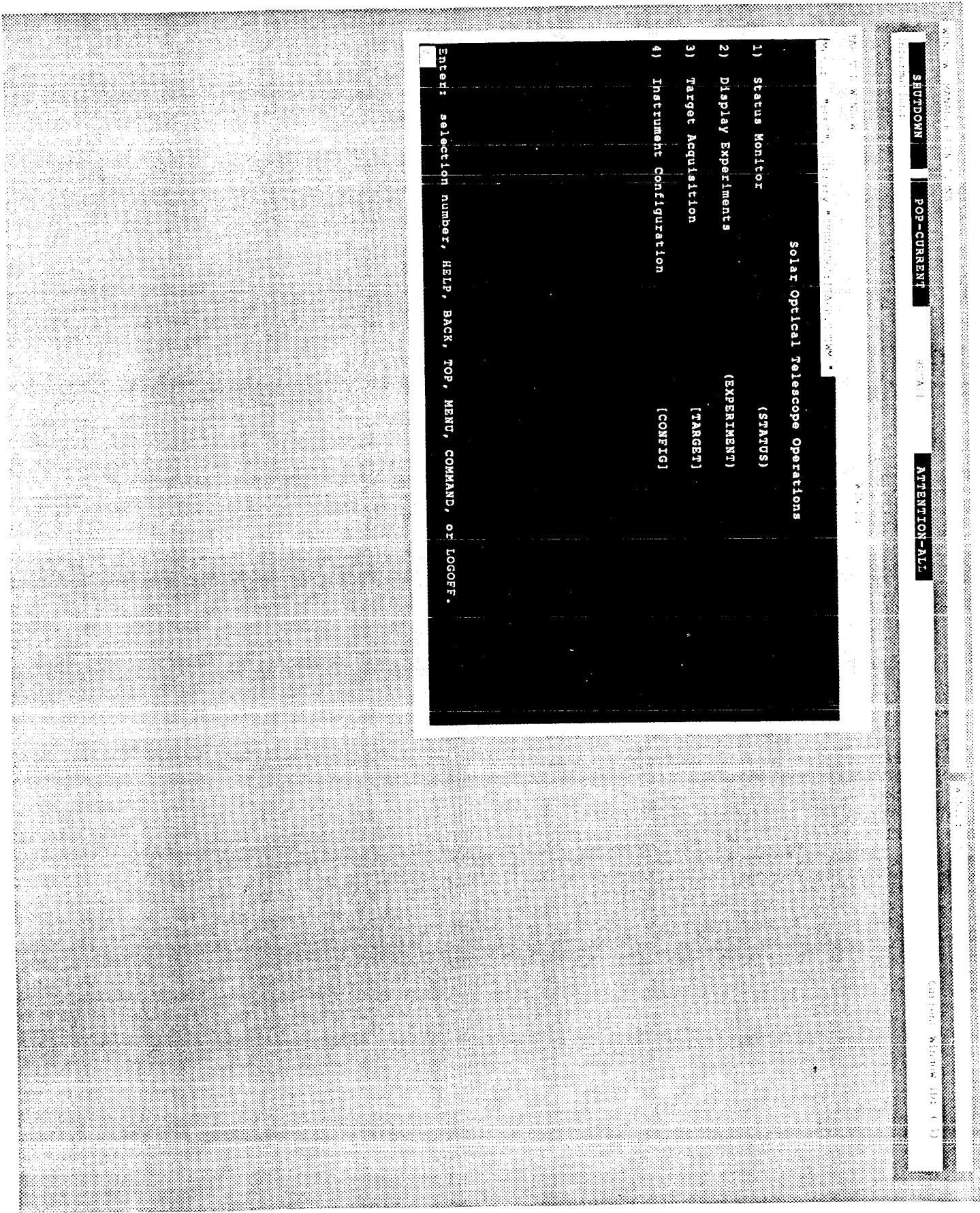


Figure 1



SHUTDOWN

POP-CURRENT

ATTENTION-ALL

Experiment List

parm	description	value
date	Today's date mo/da/yr	4/30/96

ENTER: B, REV, LINE, HELP, PAGE, QUALIFY, SHOW, RUN, EXIT, SAVE, RESTORE, RETURN to page

Pg 1.

4/30/96  
Experiment Overview

- Exp. A Scan solar periphery
- Exp. B Realtime filaments  
Instrument = slitjaw  
Region = 58
- Exp. C Calibration test

Status Monitor

Solar Optical Telescope

Parameter	Value	Unit	Status
Average Power	3.2	mW	Yes
SOY Subsystem	8.4	mW	---
T. Filtergraph	0.2	mW	---
IFS Subsystem	3.5	Kcps	812. Km
Comm Link	Enabled	Yaw	3.3s
Auto track Sys:	Enabled	Pitch	24.1s
Slit-jaw:	Enabled		
Hel1	10s		
Position in arc seconds	x=1	y=1	
Region Number:	1		

Component: Enabled: Scanning Spectrograph

Figure 2  
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MINI-MANUAL

SHUTDOWN FOR-CURRENT

EXPERIMENTAL

Information page

MANUAL

1) Move to a region (MOVTO)  
 2) Move within a region (MOVWIN)  
 3) Rotate the slitjaw (ROTJ)

Target Acquisition

Error: selection number, HELP, BACK, TOP, MENU, COMMAND, or IDCODE

4/30/96  
 Experiment Overview  
 Exp. A Scan solar periphery  
 Exp. B Resilient filaments  
 Instrument - slitjaw  
 Region - 58  
 Exp. C Calibration test

Status Monitor

Solar Optical Telescope

Average Power Consumption	Sun Centered:	No
FOV Subsystem	Temperature	8.0° K
F. Filtergraph	Torque	---
IPS Subsystem	Altitude	812. Km
Comm Link	Yaw	3.3°
Auto Track Sys:	Pitch	24.1°
Slit-Jaw:		
Roll		
Position in arc seconds	x=11	y=49
Region Number:	58	

if Comports Enabled: Scanning Spectrograph

Figure 3  
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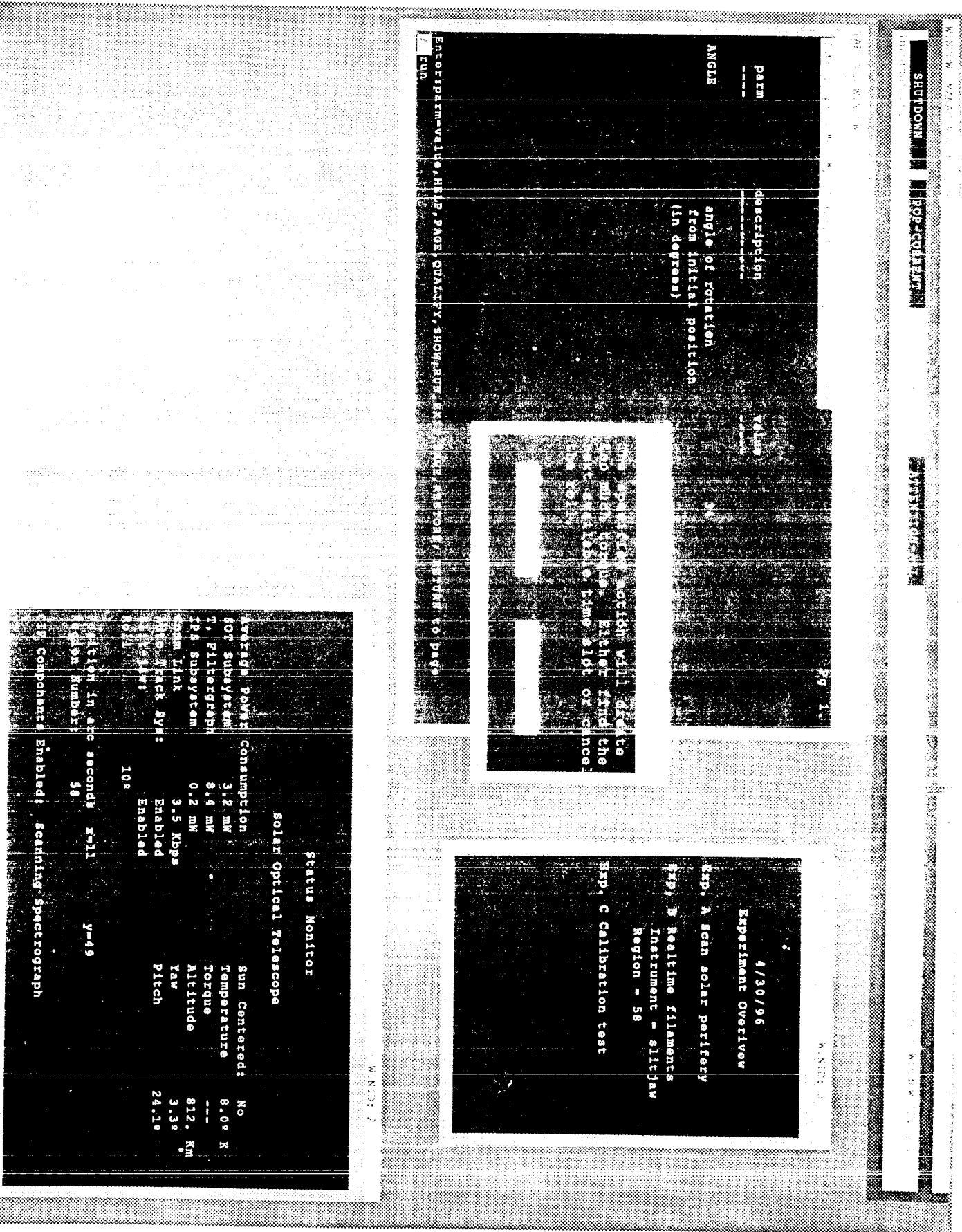


Figure 4  
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SHUTDOWN POP-CURRENT ATTENTION-ALL

Page 1

parm	description	value
FFILTER	wavelength of spectrograph filter	100
PFILTER	wavelength of spectrograph filter	0
SPECTRO	wavelength of spectrograph filter	0
REDUCE	image reduction (1 or 0.5) filter	1
EXPOSURE	CCD exposure in seconds	1

Enter parm=value, HELP, PAGE, QUALIFY, SHOW, ADV, EXIT, SAVE, RESTORE, RETURN to page  
? filter = 100

4/30/96  
Experiment OverView  
Exp. A Scan solar periphery  
Exp. B Realtime filaments  
Instrument = slitjaw  
Region = 58  
Exp. C Calibration test

The roll may be performed within the following time slots.  
Choose one:

\_\_\_\_\_

\_\_\_\_\_

Solar Optical Telescope

Status Monitor

Average Power Consumption	3.2 MW	Sun Centered:	No
ROT Subsystem	8.4 MW	Temperature	8.0° K
F. Filtergraph	0.2 MW	Torque	---
IPS Subsystem	3.5 Kbps	Altitude	912. Km
Comm Link	Enabled	Yaw	3.3°
Auto Track Sys:	Enabled	Pitch	24.1°
Slit-jaw:	Enabled		
Roll	10s		

Exposition in sec: seconds X-11 Y-49  
Region Number: 58

CS Components Enabled: Scanning Spectrograph

Figure 5  
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SHUTDOWN

POP-CURRENT

AS-AT

ATTENTION-ALL

Information:

Current Window ID: 1 3

VIEW FOR WINDOW

A SID: 1

Header: Exp MONI 1, Filterly \*EXP0002: TARP, SOLAR M

Pg 1

parm	description	value
TPFILTER	wavelength of spectrograph filter	100
PFILTER	wavelength of spectrograph filter	100
SPECTRO	wavelength of spectrograph filter	0
REDUCE	image reduction (1 or 0.5) filter	1
EXPOSURE	CCD exposure in seconds	1

Enter:parm=value,HELP,PAGE,QUALITY,SHOW,RUN,EXIT,SAVE,RESTORE, RETURN to page ? exp = 10

INFORMATION

WINDOW 4

The time for the roll has arrived.

OK

MINI-M

Experiment List

WINDOW 3

4/30/96  
 Experiment Overlver  
 Exp. A Scan solar periphery  
 Exp. B Realtime filaments  
 Instrument = slitjaw  
 Region = 58  
 Exp. C Calibration test

STATUS

WINDOW 2

Status Monitor

Solar Optical Telescope

Average Power Consumption	3.2 mW	Sun Centered:	NO
SOT Subsystem	8.4 mW	Temperature	8.0° K
T. Filtergraph	0.2 mW	Torque	---
IPS Subsystem	3.5 Kbps	Altitude	812. Km
Comm Link	Enabled	Yaw	3.3°
Auto Track Sys:	Enabled	Pitch	24.1°
Slit-jaw:	Enabled		
Roll	10°		

Position in arc seconds x=11 y=49  
 Region Number: 58

CIP Components Enabled: Scanning Spectrograph

Figure 6  
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SHUTDOWN

POP-CURRENT

HELP

ATTENTION-ALL

Information:

THE TEL WINDOW

Default: PROG=NOV, LIBRARY=OPERATORZ/TEMP.SYS

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Pg 1.

parm	description	value
ANGLE	angle of rotation from initial position (in degrees)	34

Enter parm=value, HELP, PAGE, QUALIFY, SHOW, RUN, EXIT, SAVE, RESTORE, RETURN to page  
 Press CTRL-X key to terminate

SHUTDOWN

POP-CURRENT

HELP

Information:

THE TEL WINDOW

Default: PROG=NOV, LIBRARY=OPERATORZ/TEMP.SYS

4/30/96

Pg 1.

Experiment 110  
 4/30/96  
 Experiment Overview  
 Exp. A Scan solar periphery  
 Exp. B Realtime filaments  
 Instrument = slitjaw  
 Region = 58  
 Exp. C Calibration test

STATUS

4/30/96

**Status Monitor**

**Solar Optical Telescope**

Average Power Consumption	3.2 mW	Sun Centered:	No
SOT Subsystem	8.4 mW	Temperature	8.0s K
T. Filtergraph	0.2 mW	Torque	---
IPS Subsystem	3.5 Kbps	Altitude	812. Km
Comm Link	Enabled	Yaw	3.3s
Auto Track Sys:	Enabled	Pitch	24.1s
Slit-jaw:	34s		
Roll			

Position in arc seconds x=11 y=49  
 Region Number: 58

CIP Components: Enabled: Scanning Spectrograph

Figure 7  
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