8 Software

This section describes the conceptual software design for SpeX. Some of the concepts may change as the electronic, mechanical, and dewar designs progress. Also I expect the design of the software to evolve with its implementation during the life of the development project. Possibility integrating new development tools and technologies into the project as they become available or established. For example, the Java language seem to be a promising technology, but we do not have the knowledge and experience to commit SpeX to this. However, over the project's 2+ years develop cycle, this may change.

8.1 Description of Computer Hardware.

There are 3 computer systems in SpeX. Two identical systems called Big Dog, and Little Dog. Figure 1 - Computer Hardware illustrates these computer systems, their interconnections, and physical location at the IRTF.

8.1.1 Big Dog Computer - The SpeX Image Acquisition Computers, referred to as Big Dog, will be located in the IRTF Computer Room. These computers will house the peripherals and applications for data acquisition and storage. It's software will coordinate the mechanical control and monitoring of the instruments. Provide the interface to SpeX for the observers and other computers. Basically, this is where the SpeX software will live.

There are 2 (mostly) identical system revered to as Big Dog, one controls the spectrograph and the other controls the IR guider. The configuration of the hardware and design of the much of the software in these systems will be identical. For the remainder of this section Big Dog will be revered to as a single system, but keep in mind they actually are 2 independent computer systems.

The architecture of the Big Dog will center around the VME-64 Bus. The specifications of the VME peripheral boards to be purchased are described below.

A. Single Board Computer:

Operating System:	Solaris 2.5
CPU:	Sparc 5 equivalent (110 MHz SPARC CPU)
Local Bus:	SBUS (minimum 2 slots)
RAM:	64 MB
Graphics:	1280x1024 x 8 bits SVGA
VME Interface:	VME64, Master/Slave, Slot 1 controller
	Memory Mapped VME windows.
General IO:	Keyboard/Mouse
	SCSI2
	10 MB Ethernet
Storage:	1 GB SCSI Disk (OS/Development/Applications)
	(Additional SCSI drives for data storage, size = TBD. 1024x1024 image = 4 MB.)
	CD-ROM SCSI

B. DSP Peripherals board(s). - A single DSP board with 4 DSP processor will provide the clocking and data buffering functions for the infrared array.

Desc:	Ixthos IXZ4 DSP Board.
CPU:	4 Analog Devices ADSP-210xx (SHARC)
SRAM:	4 MB (1024x1024x32 = 4 MB).

8.1.2. Little Dog Computer- The Device Monitor & Control Computer, referred to as Little Dog, will host the peripheral which are located near the instrument, such as mulitport serial controller, Analog and Digital IO, Motor Control.

A. Computer Specifications:

Operating System:	Linux
CPU:	i486/100 MHz
Local Bus:	PCI/ISA
RAM:	24 MB
Graphics:	1024x768 8 Bits SVGA
General IO:	10 MB Ethernet
Storage:	850 MB IDE Hard disk (OS, Development tools & Application)

Peripheral Board for SpeX Function:

A. Cyclade 8 Port Serial Board
1. Temperature controllers, 2 each.

B. Industrial Computer Sources ADIO1600 Analog & Digital IO board. (16 SE / 8 DF 12-bits analog input, 2 12-bits analog output, 32 Digital IO).
Digital IO requirements:
Calibration lamps (4 outputs), lamp Mirror (1 output, 2 inputs(?))

C. Oregon Microsystem's PC-58 - Intelligent Motion Controller.
Number of Axis: 8. (Dichroic, OS1, Rotator, Slit, Grating, OS2, Grating, and Focus)

8.2.3 Facility Workstation. The observer will run SpeX from a workstation located in the observer area. The SpeX project does not plan to purchased this machine, but assumes observers will use a facility workstation to run SpeX. By the time SpeX is completed, we expect the IRTF will provide observers with a workstation configured with 2 high resolutions monitors (1280x1024) supporting a singe X server across both monitors.

These systems (Big Dog, Little Dog, Facility Workstation) will reside on the IRTF's facility ethernet LAN. We expect the availability of both 10MB/100MB ethernet connection when SpeX is integrated at the telescope. We would like to recommend that the IRTF install 100MB capability to its NFS server (/data directories) and be prepared for instrumentation to connect to 10MB/100MB ethernet Hubs.

8.2 Description of Software

The SpeX software designed is heavily based on IRTF's CShell and NSFCAM software. We will not copy the current software, but rewrite most of the applications for SpeX. The major changes to the current software design are:

• The X Application will use the OSF Motif libraries. The XView toolkit and the OPEN LOOK standard is being discontinued by Sun, which standardizing on the Motif GUI design.

• The IC and XUI will execute from the same computer (Big Dog). This eliminates having to transfer each image over sockets, multiple XUI and IC path/filenames, better performance. Saving to the IRTF's /data directories will be accomplished using NFS. Remote observing will required exporting the XUI display to the remote X servers.

• Multiple copies of the XUI and Macro application will be supported (Up to 3 instances). Plus the macro and XUI will be implement as separate applications.

• The quick look data view will be implement as a VF-clone with the following improvement/changes: Floating Point based data buffers, Better support for larger array sizes, and Motif based.

• Completely new DSP architecture.

8.2.1 SpeX Applications

The development of the SpeX software can be broken down into the following 4 logical grouping:

1. Instrument Control (IC).
2. X User's Interface and Macro Application
3. Quick-look Data Viewer
4. Real-time Spectra extractions and graphics.
5. Little Dog's Device Drivers and RPC services.

Figure 2 - Data Flow and Process Diagram illustrated the communication flow and locations of these software components.

8.2.1.1 Instrument Control (IC) application.

The Instrument Control application will execute in Big Dog. Its purpose is to establish and provide the Interprocess Communication Facilities (IPC), such as shared memory and message queues, for SpeX. The IC is made up of the commands parser, data acquisition process, and monitor hardware monitoring processes. The duties of these processes are:

1. Command Parser - This process allow other programs (XUI, Macro Application) to command and control SpeX. Text command and their replies are exchanged using message queues.

2. Acquisition task - This process programs, controls, and monitors the DSP board. It also writes the acquired images as FITS to disk.

3. Monitor task - A set of processes to monitor the additional SpeX hardware located and controlled by Little Dog.

The IC will be developed using an ANSI C compiler(gcc), an RPC protocol compiler (rpcgen), and the standard UNIX libraries.

8.2.1.2 X User Interface & Macro Application

These are X applications executing on Big Dog. It is responsible for providing an easy-to-use interface to control the IC program. We do not plan to have Big Dog executing an X Server. These X client applications will be required to export their windows to another computer, such as the observer's workstation.

The XUI and Macro applications will be developed using an ANSI C compiler (gcc). The libraries used are Xmt Motif Tools, Motif 1.2, and standard UNIX libraries.

8.2.1.3 Quick look data view

An X application running on observer's workstation for displaying the FITS images produced by the IC. Custom display modes may be developed for the viewing of SpeX's data sets.

The Data Viewer applications will be developed using an ANSI C compiler (gcc). The libraries used are Xmt Motif Tools, Motif 1.2, and standard UNIX libraries.

8.2.1.4 Real-time Spectra extractions and graphics.

We are considering 2 solutions for providing the observing team with real-time extractions of spectra data and providing graphical plots of SpeX's data sets.

1. Use IDL and write procedures perform these function from within IDL.

2. Provide these facilities from within the quick look data viewer.

It is our indent to provide one or both options.

8.2.1.5 Little Dog device drivers and RPC servers.

Little Dog will provide transparent network access to its peripheral boards using remote procedure calls (ONC RPC). Also higher level applications will be written to initialize and position devices attached to SpeX's controller peripherals (Temperature controller, Motor controller, Analog and Digital interfaces). Remote computers will be able to execute and monitor these applications using remote procedure calls.

The device drivers, remote procedure calls (RPC) server, and application provided by Little Dog are:

1. Drivers and remote procedures call servers.

ad16	- device driver for the AD1600 AD IO board.
rpc.ad16	- rpc server for the AD1600 AD IO board.
rpc.tc330	- rpc server for the Lake Shore 330 Temperature Controller.
pc58	- device driver for the OMS PC-58 motor controller.
rpc.pc58	- rpc server for the OMS PC-58 motor controller.
rpc.ldog	- rpc server to allow other computer to execute and monitor Little Dog applications.

1. Little Dog Applications:

calmir_*	- Cal Mirror initialization and positioning applications
dit_*:	- Dichroic wheel initialization and positioning applications.
os1_*:	- Order Sorter 1 initialization and positioning applications.
rotator_*:	- Rotator initialization and positioning applications.
slit_*:	- Slit wheel initialization and positioning applications.
os2_*:	- Order Sorter 2 initialization and positioning applications.
grating_*:	- Grating initialization and positioning applications.
focus_*:	- Focus drive wheel initialization and positioning applications.

All applications and drivers in Little Dog will be developed using an ANSI C compiler (gcc), a RPC protocol compiler (rpcgen), and the standard UNIX libraries.

8.3 Previews and Screen Illustrations

With SpeX, we will try to implement a "duel screen" observers station. We would like the facility workstation on the IRTF to be configured as a single X server running across 2 monitors. We feel 2 screens is the amount of real estate needed for a single person to comfortably operate SpeX. Figure 3 illustrate the display organization intended for the SpeX software from the observer's view point

Figure 4 is a snap shot of actually applications currently being developed for SpeX. Shown are the XUI, Data View, and Macro Application.

Figure 8.1 - Location and Interconnection of Computer Systems

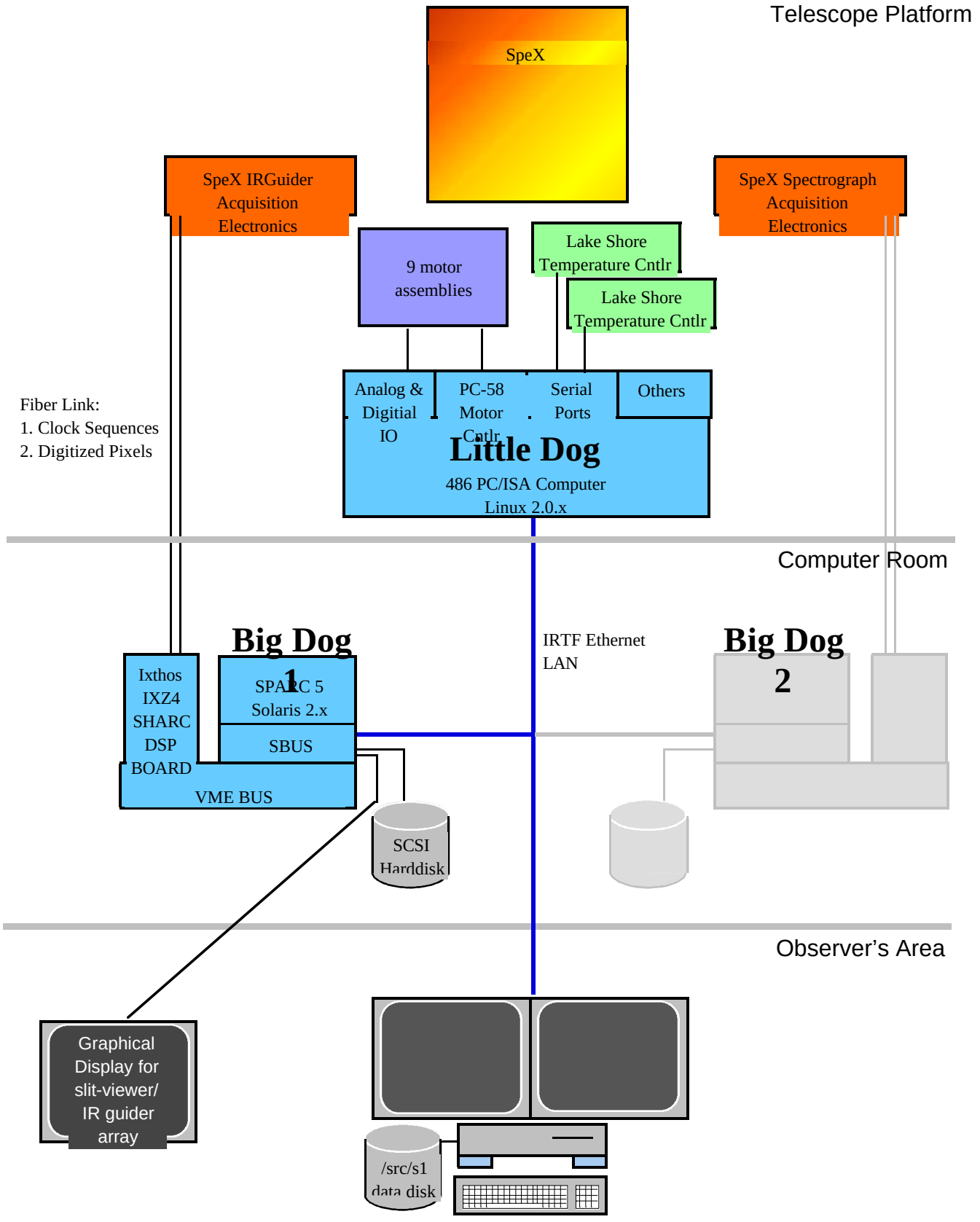

Figure 8.2 - Software components and communication flow

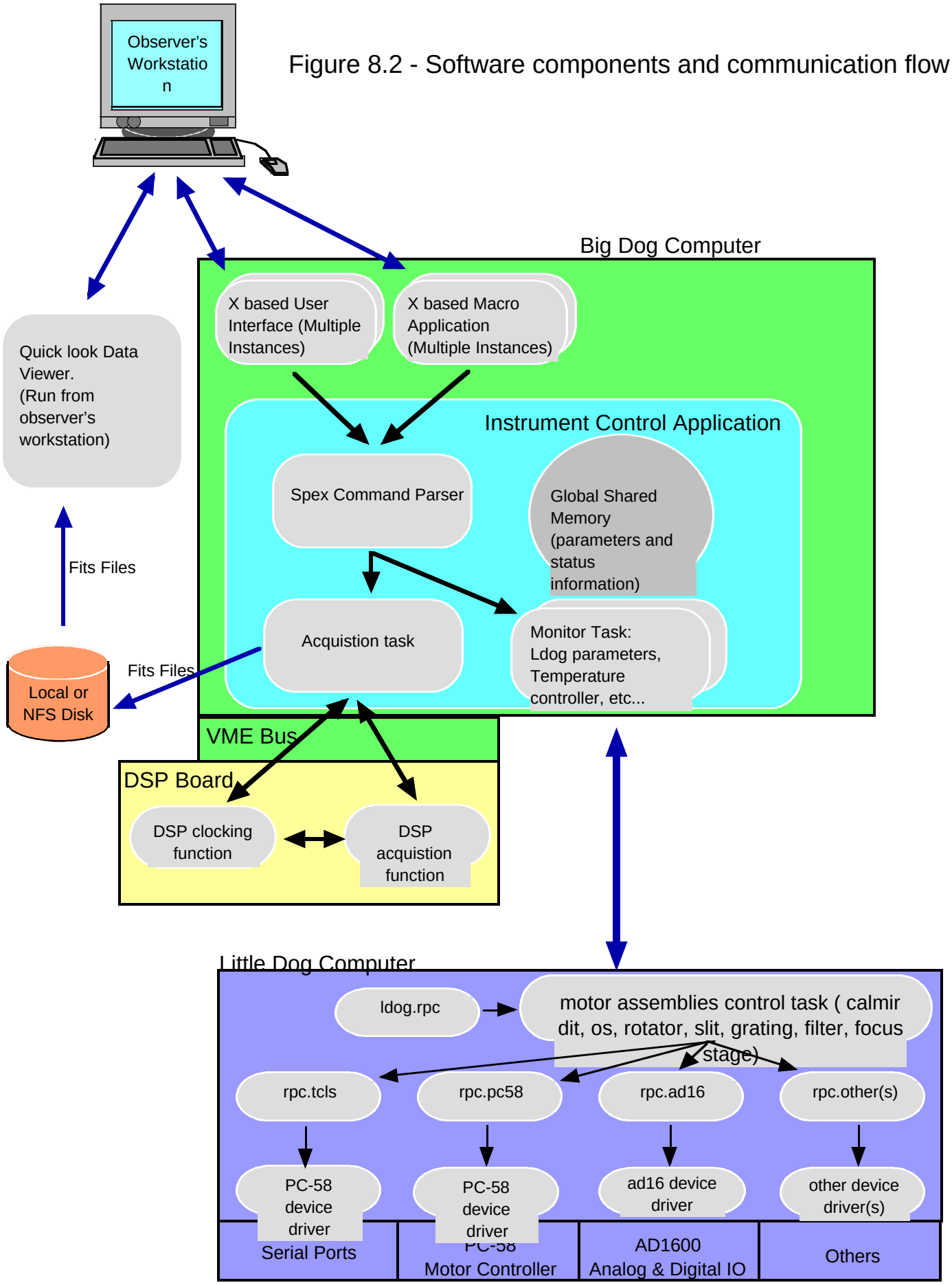

Figure 8.3 - Illustration of the SpeX User Interface

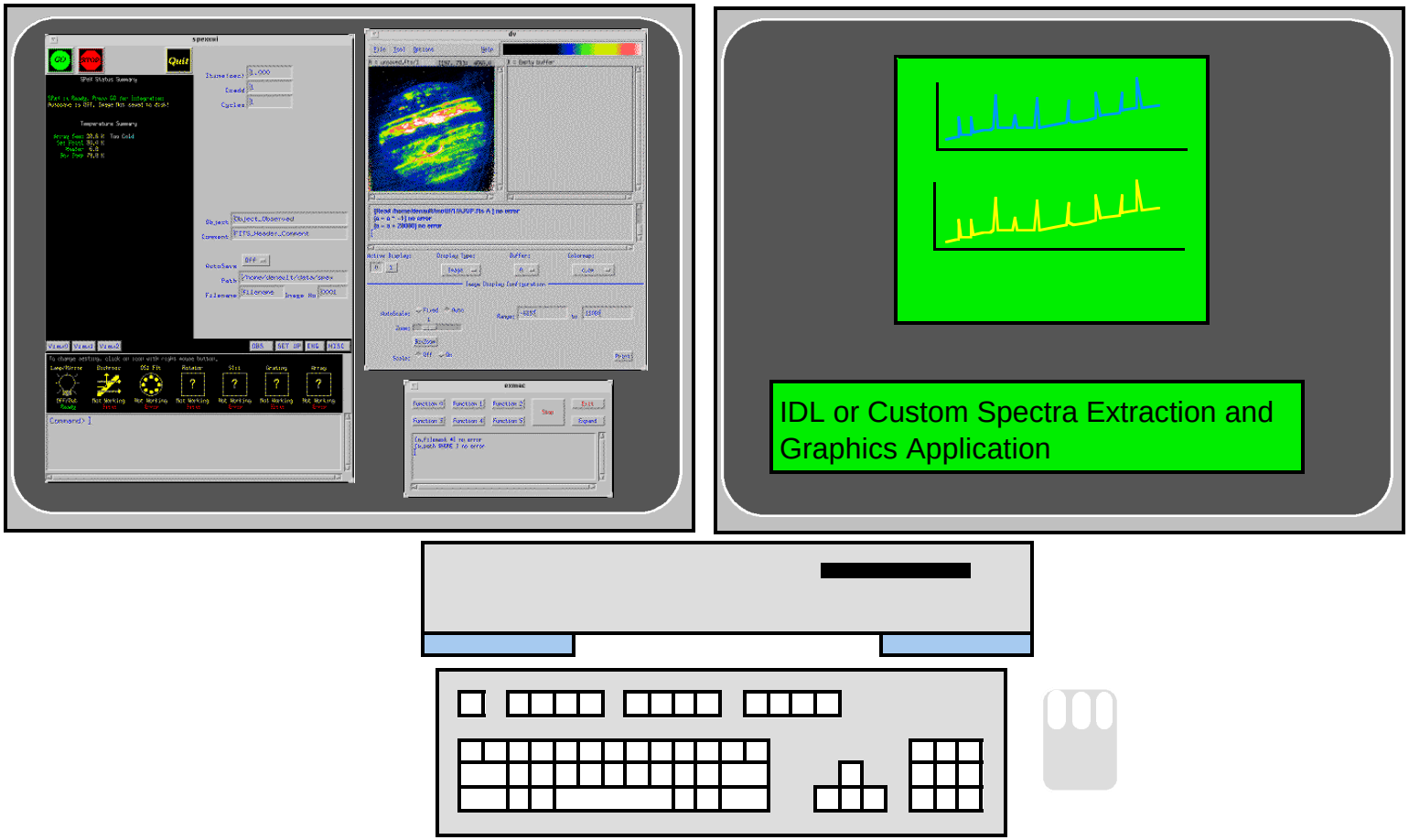

Figure 8.4 - Observer's Graphical Interface (as of Sept, 27, 1996)