

(B) What is the Chemical Composition in the SMC?

The discrepancy between the abundance determinations either from detailed analysis of stellar atmospheres or from studies of emission spectral lines in nebulae would not be as large as it seems. Indeed, in the first case, abundances of elements such as titanium, chromium, iron, calcium are determined, whereas the emission spectrum of nebulae leads to the determination of the abundance of helium, oxygen, nitrogen, sulfur, argon, and sometimes chlorine. These last elements could be slightly underabundant with respect to the iron peak elements. What does it mean, if it is significant, and if the abundance of iron in AZ369 is representative of the iron abundance in the recently synthesized material in the whole

SMC? Light elements, like oxygen, are mainly synthesized in massive stars, and iron peak elements originate from type 1 supernovae, of which progenitors are less massive stars. Therefore the ratio of the number of massive stars to the number of intermediate mass stars would be smaller in the SMC than in the solar neighbourhood. The initial mass function would be steeper in the SMC than in our galaxy.

Thus, what to do to achieve further progress?

Try to derive the oxygen abundance in stars, which is difficult, or to observe fainter stars, so that problems in the interpretation of the spectrum are much less severe. We hope to do that with the new CASPEC spectrograph at the 3.6 m telescope at La Silla.

MIDAS — ESO's New Image Processing System

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Introduction

In 1979 ESO began the planning and development of a new image processing system to fulfill the data analysis and image processing needs for the 1980's. It was decided to use a powerful 32-bit super-mini computer with virtual memory management as the basis for this development. The VAX 11/780 computer of Digital Equipment was chosen mainly because of its user-friendly operating system, VMS, and because the VAX had been selected by several other astronomical institutes. Indeed, the STARLINK system in the U.K. and the FIPS system developed at ESTEC for the Faint Object Camera are based on VAXes.

Soon after ESO's move to Munich, the first VAX 11/780 was installed and the actual development began. The software system was given the name "MIDAS" which stands for **Munich Image Data Analysis System**. In mid-1981, the image display systems were delivered, and in late 1981, the second VAX was installed. The developments progressed to the state where local users began using the MIDAS system in early 1982 and they have reached the state where outside users are being encouraged to use the system for analysing CCD data; however, at the present time the reduction package is not totally completed. Of course, the range of applications of MIDAS is growing rapidly beyond the CCD.

In addition to developing MIDAS for use at ESO in Munich, some effort has been put into making the system easy to transport to other VAXes with different graphics and image peripherals. A copy of MIDAS will be installed on La Silla soon after the VAX arrives.

Hardware Elements

The hardware configuration of MIDAS in Munich is shown in Fig. 1. The important components are the VAX CPUs with their associated disk and tape subsystems, the image display systems, and the Dicomed image recorder.

The heart of the system is the two VAX 11/780 computers linked together via DECnet. VAX-A is equipped with 3.5 Mbytes of memory, 1.2 Gbytes of disk storage and 2 tape drives with 800/1600 bpi density. VAX-B has 4.0 Mbytes of memory, 688 Mbytes of disk storage and one tape drive with 1600/6250 bpi density.

The philosophy behind the disk and tape arrangements was to enable users to keep an important quantity of their data on disk while they are actively reducing it and only to use tapes at the beginning and end of their work.

The image display systems used for MIDAS in Munich are 3 Gould-DeAnza IP-8500 systems. Each system is equipped with a powerful Digital Video Processor (i.e. an array processor processing entire frames of 512*512 pixels at video rates), and supports two user stations with each station having its own cursor and overlay. Currently each station has 4 image channels and 1 overlay channel of 512*512*8 bits each, as well as an alpha-numerics memory of 20*80 characters. Two of the IP-8500 systems are connected to VAX-A and one to VAX-B.

The DeAnza system of VAX-B includes also a video digitizer system connected to a TV camera. This system allows pictorial and graphical data to be entered quickly into the computer for making overlay and so forth.

The Dicomed image recorder serves as a high resolution hardcopy device for publication and reference. The output is normally on regular roll film and is of excellent quality. Fig. 2 shows an example of some output from the Dicomed.

In addition, a Versatec plotter is connected to each VAX. An HP plotter is also available on VAX-A.

The MIDAS work station is very similar to the one of IHAP. Each of the six MIDAS work stations consists of a DeAnza display, a VT100 terminal for command input and data in/output, and an HP 2648 terminal for graphic output. However, MIDAS procedures which do not require the interactive peripherals can be run from any terminal connected to the VAX. Output to the Versatec, HP Plotter and Dicomed is spooled like output to the printer.

The MIDAS Software Environment

The design of MIDAS was influenced by the following factors:

- The system should be compatible with the other major astronomical image processing systems which are currently developed, i.e. Starlink of Rutherford Appleton Laboratories in England, the Faint-Object-Camera Image Processing System of ESTEC in Holland and the system for the Space Telescope Institute in Baltimore.

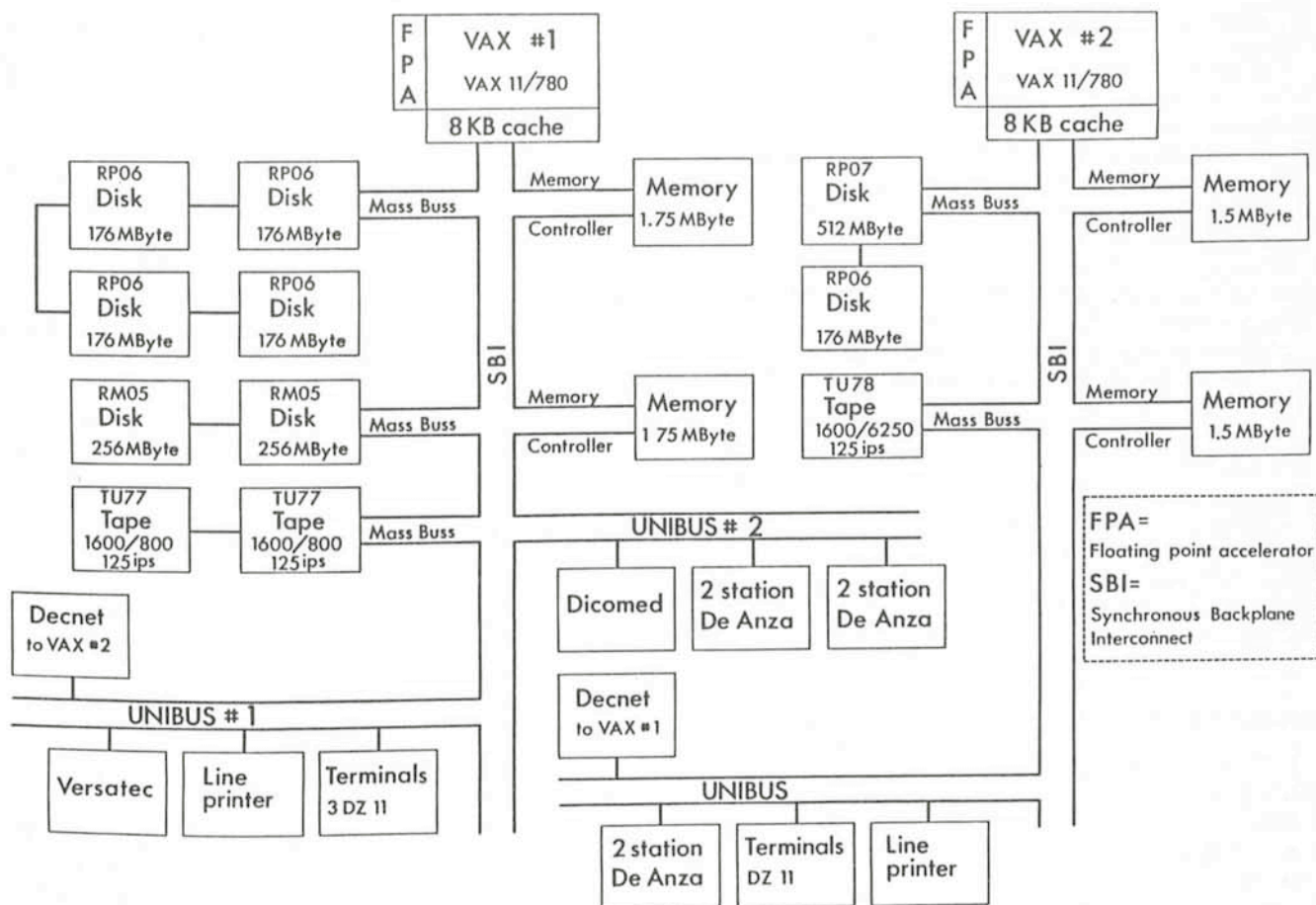


Fig. 1: The hardware configuration of MIDAS.

- The experience and insight gained with the highly successful IHAP, ESO's current Image Processing System based on HP 1000-F computers, should be used.
- MIDAS will be used heavily by visitors, thus it should be quick and easy to learn the basic features of the system.
- A modular system with simple interfaces to data structures, e.g. images, is required to facilitate implementation and conversion of existing application software from other institutions.

The above considerations led to an implementation of MIDAS with the following features:

- Like IHAP it is a command-driven system geared towards the interactive user. The structure and syntax of MIDAS commands has been modelled after DCL, the command language used on the VAX with the VMS operating system. A command line may be up to 200 characters long and is structured as

command/qualifier par1 par2 ... ! comments.

The "command" describes the general action to be performed (an English verb) and the qualifier specifies how to perform the action (an adverb). For example, the command:

WRITE/KEYWORD KEY DATA

stores "DATA" into the "keyword", named KEY.

- The type and number of parameters in a command depends on the particular command invoked. The parameters are position-dependent, but this can be overridden.
- An extensive on-line help facility provides detailed descriptions of all commands and qualifiers.
- MIDAS is a very modular system that provides building blocks for making more sophisticated applications. In fact, most of the "commands" are not commands at all, but MIDAS procedures which are a series of "commands" linked

together with control structures to perform the desired operation.

- Conditional branching, nested looping, local/global variable substitutions and calls to other procedure files are features of a MIDAS command procedure.

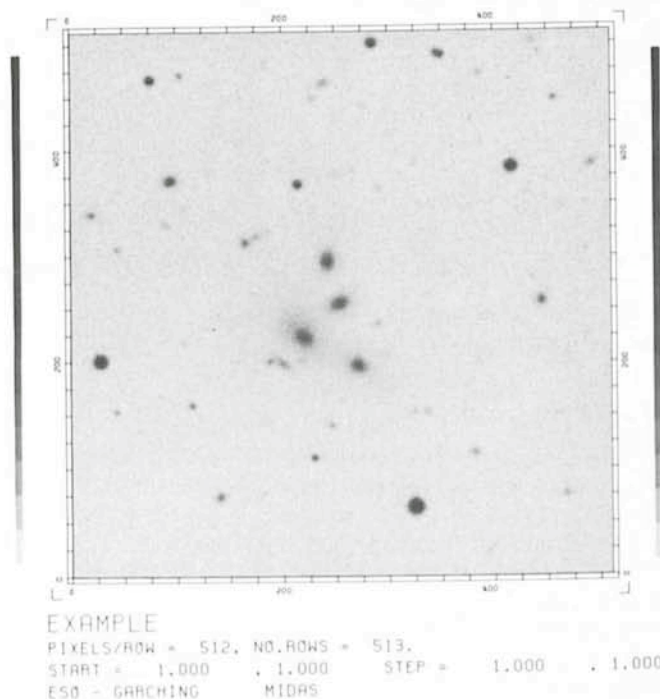


Fig. 2: An example of some output of the Dicomed image recorder.

- MIDAS supports several data structures. These are outlined below:
 - Images, a collection of data of the same physical significance (cf. IHAP).
 - Tables, data which can be arranged in rows and columns and not necessarily of the same physical significance. Tables are extremely useful in handling the results of various operations such as lists of magnitudes.
 - Descriptors, the information which is associated with images or tables. These would typically be the name of an image and the number of pixels on each axis as well as many other things.
 - Keywords, variables which provide communication between different MIDAS application programmes. For example, the position of the cursor is normally stored in a keyword and then passed to a subsequent application programme.
- Input to MIDAS is either via the terminal keyboard or from ASCII files, which are the MIDAS command procedures. These files may contain any supported MIDAS command but also the control structures similar to those of high-level programming languages.
- MIDAS users keep a reasonable amount of their data on disk during the time they wish to work. Thus no time is lost in moving data from magnetic tape to disk and vice versa. For this purpose, several "public" disk areas of various sizes have been established for which a MIDAS user can obtain exclusive access for a certain time.
- Two commands have been created to read and write magnetic tapes. These procedures support IHAP, FITS and DEC's BACKUP format on input as well as FITS and BACKUP on output.
- Single images may be viewed in monochrome or with pseudo colours. If the 3-colour components of an image exist, they may be overlaid to work in real-colour mode (cf. Fig. 2, page 27 in *Messenger* 30, Dec. 1982).
- Extract subimages interactively via cursor window or at fixed coordinates.
- Plot scan lines, contours and perspective views.
- Rotation, flip, rebin and filter images.
- Execute arithmetic operations and the usual FORTRAN functions on images and tables as well as Fast Fourier transformations.

It is envisaged that several application programme packages will be developed within the MIDAS environment. These will function and be documented along the lines of the IDS reduction package that has been available in the IHAP system for several years.

The first astronomical application package implemented in MIDAS handles CCD frames. The CCD images are cleaned by minimizing permanent instrumental defects, such as low sensitivity columns, bad rows and hot spots and by removing various kinds of random artifacts. In its present state, MIDAS will be most useful for astronomers wishing to reduce CCD data.

Other astronomical applications in the areas of 2D-photometric and spectroscopic reductions are currently being developed for MIDAS and will be fully integrated soon.

Documentation

An extensive users guide has been written which describes the MIDAS system as it currently exists and how to use these features. As new features are added, the users guide will be updated. This includes descriptions of the data structures, detailed descriptions of the individual commands, and information on how to use the special-purpose peripherals such as the Dicomed image recorder.

A guide to writing an application programme for the MIDAS system is also available. It describes the FORTRAN interfaces to the MIDAS data structures. This will prove useful to those people who wish to generate special-purpose commands for their own particular application.

Finally, a MIDAS installation guide and MIDAS system description have been written, but their status is less well developed than the previous two.

Applications

At the present time MIDAS provides a comprehensive set of basic image processing functions. There are currently about 175 commands available in the MIDAS system. A short overview of the most interesting ones is given below:

- Load images and colour-lookup-tables into the image display and read them back into VAX memory.
- Modify the colour-lookup-table interactively to enhance various image features.
- Zoom and scroll images interactively or with fixed values.

Absorption-Line Spectroscopy of Close Pairs of QSOs

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Introduction

QSOs can be used as sensitive probes of the intergalactic medium. They are strong and distant sources of continuum radiation, against which intervening material may be discerned in absorption and mapped as a function of redshift. Close QSO pairs, which by chance have small separations (\leq few arcmin) on the plane of the sky, expand these possibilities; they provide twin lines of sight over vast distances, giving direct information on the lateral sizes of the intervening absorbing regions distributed along these lines of sight, and on the presence of absorbing material in the immediate vicinity of the foreground QSOs themselves.

Two distinct types of absorption lines are found in QSO

spectra. There are broad absorption troughs adjacent to the emission lines in about 10 per cent of QSO spectra; these are high-excitation systems, and are thought to be due to gas which has been expelled from the QSO nuclei. The origin of the other type of QSO absorption lines is more controversial: narrow absorption lines (widths of a few hundred km s^{-1} or less) are found in most QSO spectra, with any redshift up to approximately that of the QSO. They could conceivably also be due to matter which has been expelled from the QSO at highly relativistic velocities, but the most widely accepted view is that they are due to matter cosmologically distributed along the line of sight to the QSO and unassociated with it. These in turn fall into two categories: systems containing heavy-element