

## 2. MIDAS Workshop

The MIDAS Workshop on April 28, 1988, was attended by approximately 70 people, 50 of whom came from other institutes. The morning was reserved for presentations of the general status of MIDAS and new applications such as the IRSPEC package. J. Nichols-Bohlin from the IUE project at NASA, Goddard Space Flight Center, presented the implementation of the IUESIPS package in a MIDAS environment which is now used for the production calibrations.

The standard Image Display Interfaces were described briefly with a more detailed discussion of the first IDI implementation for X-window systems made in Trieste Observatory.

The afternoon was devoted to the portable MIDAS. The new portable set of Standard and Table interfaces was reviewed. These new interfaces represent an enhanced version of the old ST and TBL routines which will still be supported for VAX/VMS systems.

The version 3.0 of AGL, used for plotting in the portable MIDAS, was presented by L. Fini from ASTRONET. Further, the increased capabilities of the plotting package available in the portable MIDAS was demonstrated with a new plotting tutorial. Finally, an extensive set of tests and benchmarks on work-stations from 12 vendors was discussed.

MIDAS courses were discussed again and a decision made to try and arrange

these once the portable MIDAS has been released.

## 3. New Release Dates for MIDAS

With the growing number of institutes now receiving MIDAS (more than 80 sites), our workload is increasing with each release and the summer release is causing problems due to the vacation period. It has therefore been decided to change the MIDAS release dates to May 1<sup>st</sup> and November 1<sup>st</sup>. Thus, the next release will be made November 1<sup>st</sup>, 1988, and be named 88NOV. A first version of the portable MIDAS will be offered at this release. The present VAX/VMS version of MIDAS with minor updates will also be made available to sites which e.g. at that time have not updated their IDI routines to the final standard used in the portable MIDAS.

## 4. Portable MIDAS

The basic tests of the portable version of MIDAS have been completed successfully by implementing and benchmarking the system on more than 18 different computer models from 12 vendors. These vendors include: HP, Apollo-Domain, SUN, Bull, Tektronix, Masscomp, Alliant, IBM, DEC, Prime, PCS and Eltec. The very high degree of portability was demonstrated by the easy installation of MIDAS on all these systems representing 13 different operating systems (VAX/VMS and 12

UNIX-like systems from pure BSD to SYS V), 5 RISC CPU's and 3 CISC processors. For a typical system, the full installation, testing and benchmarking were performed in less than two working days.

These tests have fully proven the design and portability concept of MIDAS. The main task is now to migrate and test the application programmes with the portable MIDAS. At this stage, the table and plotting applications have been re-designed and implemented in the portable version of MIDAS. This part includes about 40 commands now running in the VMS and UNIX environments. It is expected that a major part of the applications will be available before the 88NOV release.

## 5. MIDAS Hot-Line Service

The following MIDAS Support services can be used in case of problems to obtain fast help:

- EARN: MIDAS@DGAESO51
- SPAN: ESOMC1::MIDAS
- Tlx.: 52828222 eso d, attn.: MIDAS HOT-LINE
- Tel.: +49-89-32006-456

Also, users are invited to send us any suggestions or comments. Although a telephone service is provided it should be used in urgent cases only. We prefer that requests are submitted in written form through either electronic networks or telex. This makes it easier for us to process the requests properly.

# IRSPEC Spectra Reduced within MIDAS

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## 1. Introduction

The ESO 32-channel infrared (1–5  $\mu\text{m}$ ) grating spectrometer, IRSPEC, was put into operation and made available for Visiting Astronomers in October 1986. In this contribution we describe the reduction scheme implemented in MIDAS to process IRSPEC data taken in any of the two – discrete or continuous – instrumental modes. The Instrument itself has already been described in detail in another contribution to the *Messenger* (ref. 1).

The main purpose of this package is to provide the tools for converting the raw data counts into spectral flux, calibrated in wavelengths. The design of the

reduction method is very flexible, in the sense that the user can process the data in different ways, using the basic tools provided by MIDAS, according to his/her own preferences. One important point in the design is to allow for the propagation of errors when an arithmetic operation is performed between two spectra and, of course, the ability to display and plot the error bars. This may be important as the present range of spectral resolutions available in IRSPEC is such that the intrinsic noise level of a measurement may not be well represented by the average pixel to pixel variations in the final spectra. Plotting the final error bars will, for example, tell the observer whether the main source of noise was introduced by bad cancellation of telluric absorption features or detector noise.

All the intermediate data are stored in tabular format. The calibrated flux can then be converted into a one-dimensional image, so that it is possible to use the spectral analysis facilities already available in the system to compute line intensities, equivalent widths, central wavelengths, etc.

## 2. The Reduction Steps

Spectra obtained with IRSPEC are read from magnetic tapes written in FITS format. Therefore, if a visiting astronomer anticipates reducing these data using MIDAS, he/she should request the computing centre at La Silla to write his/her magnetic tapes in FITS format. Otherwise, the IHAP tapes can be copied into FITS format before reduc-

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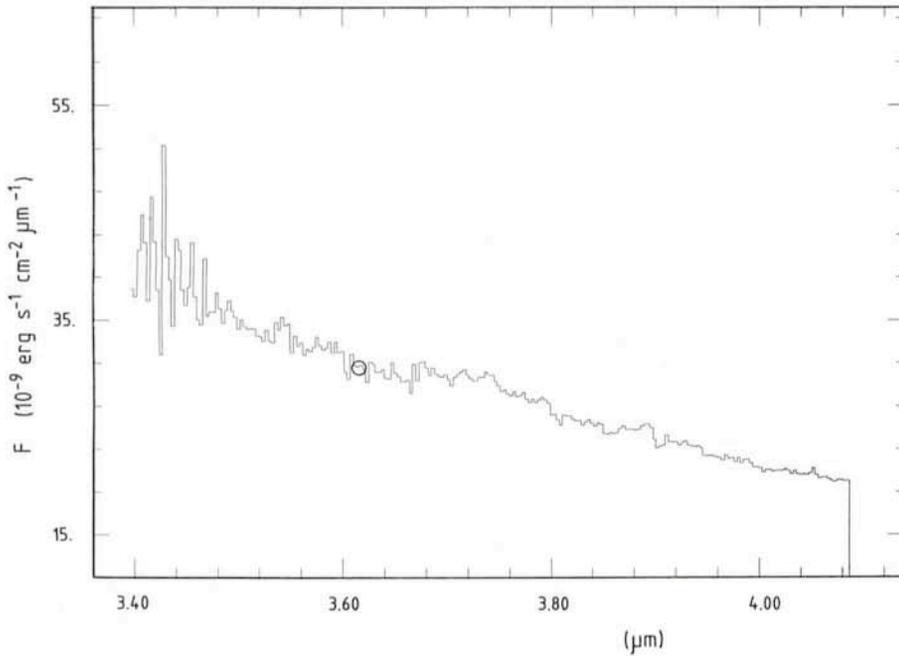


Figure 1: *Reduced spectrum of the standard star HR 5459, calibrated using the standard star HR 6746. The circle corresponds to the flux of HR 5459, determined photometrically in the L band.*

tion (see refs. 2 and 3 for details about the data format).

The basic steps of the basic IRSPEC reduction are:

(1) To perform wavelength calibration. The wavelength calibration is made by converting pixel positions into wavelengths, using a polynomial fit to laboratory measurements of a spectral calibration lamp and the theoretical dispersion formula. This calibration is done in a fully automatic procedure. As explained in ref. 2, the observer does not need to worry about making independent wavelength calibration, as the laboratory calibration formula provides accuracy to a fraction of a pixel. The grating position and stability of the instrument may be checked before each observing night in the way described in ref. 2. As a matter of safety, the observer may also record calibration spectra of any of the spectral line lamps available.

(2) To detect and correct "spikes" present in the scans. During this interactive step it is possible to reject individual pixels in a given scan or to eliminate one or several scans completely. New average counts with corresponding errors are then calculated using the selected information.

(3) To merge all spectra taken with the same wavelength parameters in a table. This table will be used as a working space where all the reduction operations will be carried out. Therefore, it is essential to make the observations of programme objects and standard stars – and optional calibration lamp exposures – in sets with *precisely the*

*same wavelength parameters.* Otherwise, each individual spectrum, calibrated in wavelengths, will have to be rebinned into an image file, losing the possibility of error information and decreasing the flexibility of the reduction scheme.

(4) To compute the ratios between object counts and standard star counts. The detailed mathematical computations between spectra are decided by the user, depending entirely on the programme and methodology set by the observer. Basically, the result will be a series of spectra of programme objects divided by standard stars, cancelling in this way both the instrument response and atmospheric transmission characteristics.

(5) Flux calibration. This is done by fitting the coefficients  $A$  and  $B$  in the function  $F_\lambda = A\lambda^B$  to the broad-band photometric data of a selected standard star. The coefficients are then used to convert the count ratios, computed in the step above, into flux. Tables with the fluxes of the observed standard stars have to be provided. Because of the flexibility of the reduction scheme, it is possible to select the standard stars from the ESO list of JHKLM standards, with the user's choice of zero-magnitude fluxes, or to include tables with standard stars defined in the system of your choice.

(6) To convert the final reduced spectra into one-dimensional images, so that any of the standard spectral analysis commands may be used.

At any of the previous stages, it is possible to generate plots or to use any

of the available table commands to interact with the intermediate results. The present implementation includes a tutorial procedure to illustrate all the reduction steps described above.

### 3. Comments on the Accuracy of the Reduction

The actual accuracy achieved in the wavelength calibration step depends on how well calibrated the grating position was at the time of the observations. Naturally, this can be checked before each observing night. The estimated rms error for the measured lines in four independent calibration lamp exposures in the J and H bands was  $0.0002 \mu\text{m}$ , which is about two tenths of a pixel.

The flux calibration is, at present, accurate to at best 5%. This depends strongly on the choice of the standard star and, naturally, on the sky transparency stability. As an illustration, Figure 1 shows the spectra of the standard star HR 5459 calibrated using standard star HR 6746, this time in the 3.5 to  $4.05 \mu\text{m}$  region. The symbol  $\odot$  marks the L band flux of HR 5459 determined photometrically.

As another example, the J band IRSPEC spectrum reduced with the MIDAS IRSPEC reduction package of the supernova 1987A in the Large Magellanic Cloud is shown in Figure 2. These data were obtained by T. Le Bertre the night of 29/30 May 1987. Figure 2a displays the counts with associated error bars. Figure 2b is the calibrated flux, the symbol  $\odot$  marks the independent J-band photometric flux corresponding to that night.

### Acknowledgement

We are indebted to A. Moorwood and A. Moneti for their contributions during the design of the reduction method. We

## ESO Book Soon Available in Spanish and French

A Spanish edition of the ESO book "Exploring the Southern Sky" (see the *Messenger* 49, 43) is now being prepared. It will soon become available in major bookstores in Spain and other Spanish-speaking countries, also in South America. Information about this edition may also be obtained from the publisher: Equipo Sirius (Tribuna de Astronomía), Desengaño 19-10<sup>o</sup>, E-28004 Madrid, Spain (telephone: [91] 521 6008).

A French version will become available from Les Editions de Physique later this year.

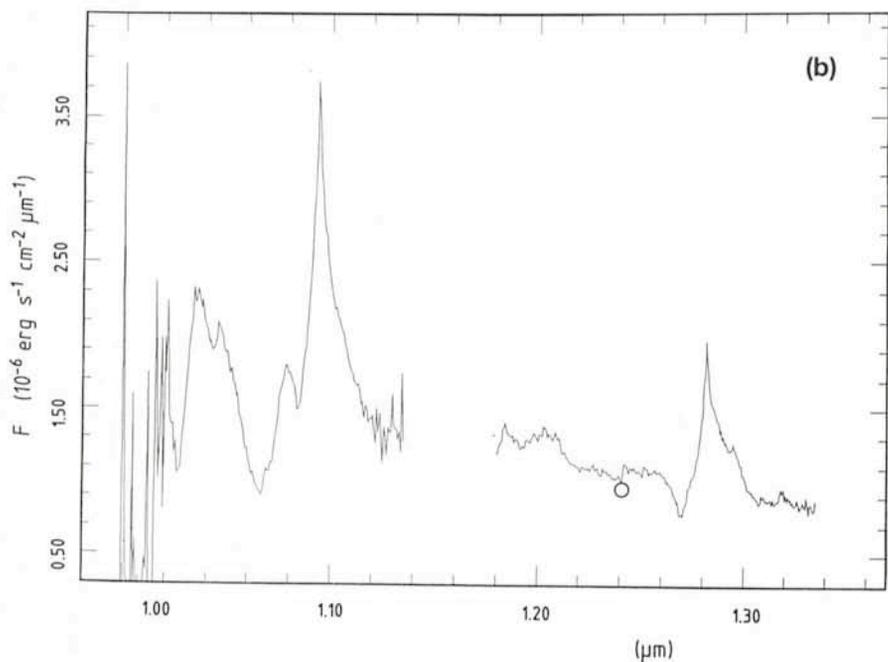
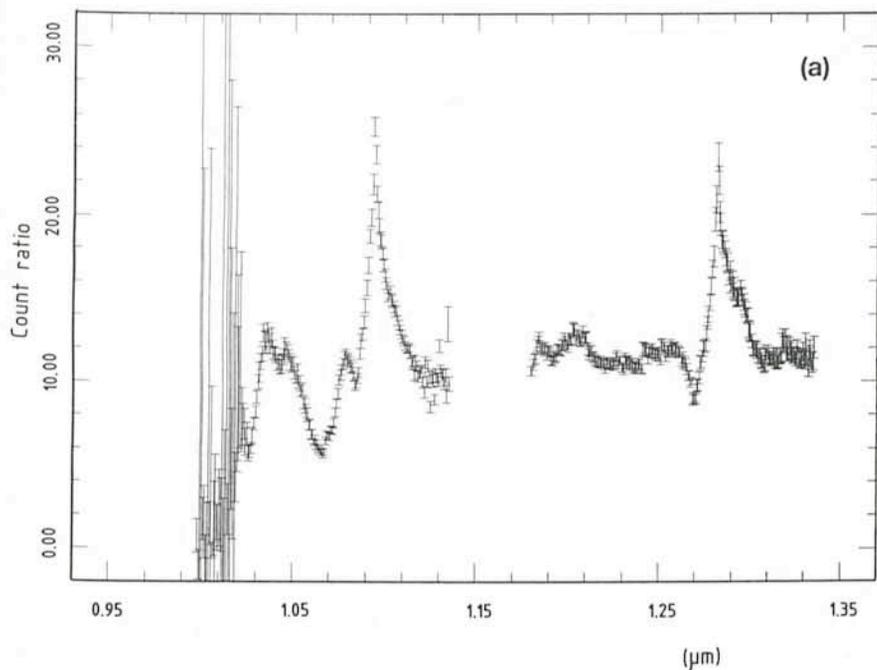


Figure 2: Spectrum of SN 1987A in the J band observed during the night 29/30 May 1987, reduced with the IRSPEC package in MIDAS. (a) Observed counts with associated errors. (b) Calibrated flux, the circle marks the J band photometric flux, determined independently during the same night.

are also indebted to T. Le Bertre for providing the SN 1987A data used for testing purposes.

#### References

1. A. Moorwood, P. Biereichel, G. Finger, J.-L. Lizon, M. Meyer, W. Nees and J. Paureau: 1986, *The Messenger*, No. 44, p. 19.
2. A. Moorwood: 1986, *IRSPEC Operating Manual*.
3. P. Biereichel: 1986, *IRSPEC Software Operating Manual*.

## ESO at the IAU General Assembly

The XXth IAU General Assembly will take place in Baltimore, from August 2–11, 1988. Following the previous Assemblies, in Greece (1982) and in India (1985), it is expected that at least 2,000, perhaps even 3,000 astronomers will convene this year to discuss almost any aspect of modern astronomy. The

General Assembly therefore also provides an excellent forum for presentation of the organizations connected with this science.

Among other exhibitors, mostly from North America, ESO will mount a small display in a booth at the Assembly. The 16-m Very Large Telescope will be shown by a new model and various aspects of the science and technology at ESO will be illustrated by drawings and photos. Brochures with details about ESO will also be available for hand-out.

See you at the ESO booth in Baltimore!

## ESO Grid Processing Machine



After much testing and several modifications, the prototype of the automatic ESO Grid Processing Machine (see also *The Messenger* 46, 7, December 1986) is now ready. Its superiority over the Tray Rocker has been confirmed, both in terms of development efficiency and uniformity. It will therefore replace the Tray Rockers at ESO for the processing of large photographic plates. Practical tests will be made later this year at the ESO Schmidt telescope, together with the new Kodak T-max plates. When properly sensitized, these plates appear to reach fainter limiting magnitudes than the IIIa-J emulsion. Thus, it is thought that the combination of the new emulsion with the more efficient development technique may lead to higher detective quantum efficiency. The results of these tests will be announced in a later issue of the *Messenger*. Interested observatories can obtain further information about the Grid Processing Machine from the ESO Information Service (address on last page).