

the net detector quantum efficiency is low, (b) the number of bad pixels is a function of detector integration time, and (c) the streaking effect. The limits in actual performance are imposed by improper subtraction of the bad pixels and of their streaks. The combination of these problems makes the new array unsuitable for work under low background conditions, e.g. in the J band, in the H and K bands when working at high spatial resolution, with the 1.5–2.5  $\mu\text{m}$  CVF and eventually with a Fabry-Perot etalon.

Under high background conditions (K at low spatial resolution and L), where there is sufficient sky background to overcome most of the streaking problem, good results can be obtained. Here one is limited by (a) improper subtraction of the first few pixels of the streaks from the hot pixels, which add noise to the sky background, and (b) the source of interest falling on a bad pixel, thus increasing the uncertainty in the photometry.

Table 4: Limiting sensitivities

| Filter | Sky (mag/sq. arcsec) | 1 $\sigma$ /pix | 5 $\sigma$ /beam |
|--------|----------------------|-----------------|------------------|
| H      | 12.8                 | 19.5            | 15.6             |
| K      | 10.7                 | 19.5            | 15.6             |
| L      | 1.7                  | 14.2            | 10.3             |

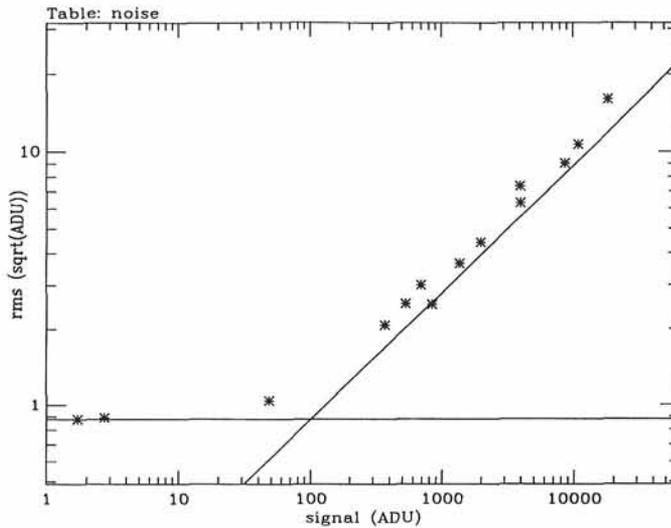


Figure 5: Measured RMS noise vs. signal. The horizontal line indicates the RON, and the diagonal line shows the expected noise for background limited performance.

## Photographic Astronomy with MAMA

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MAMA (Machine Automatique à Mesurer pour l'Astronomie) is a fast and accurate multichannel microdensitometer developed and operated by INSU and located at Observatoire de Paris. MAMA processes in a few hours photographic plates up to 14'  $\times$  14' with a positional accuracy of 1  $\mu\text{m}$  (repeatability: 0.2  $\mu\text{m}$ ) and a photometric accuracy of 2 per cent over a dynamical range of 3 densities. The detector is a RETICON CCPD array with 1024 photodiodes. The plate can be digitized either in a systematic way by lanes 10.24 mm wide, or in a random access mode from a catalogue of preliminary positions. The basic

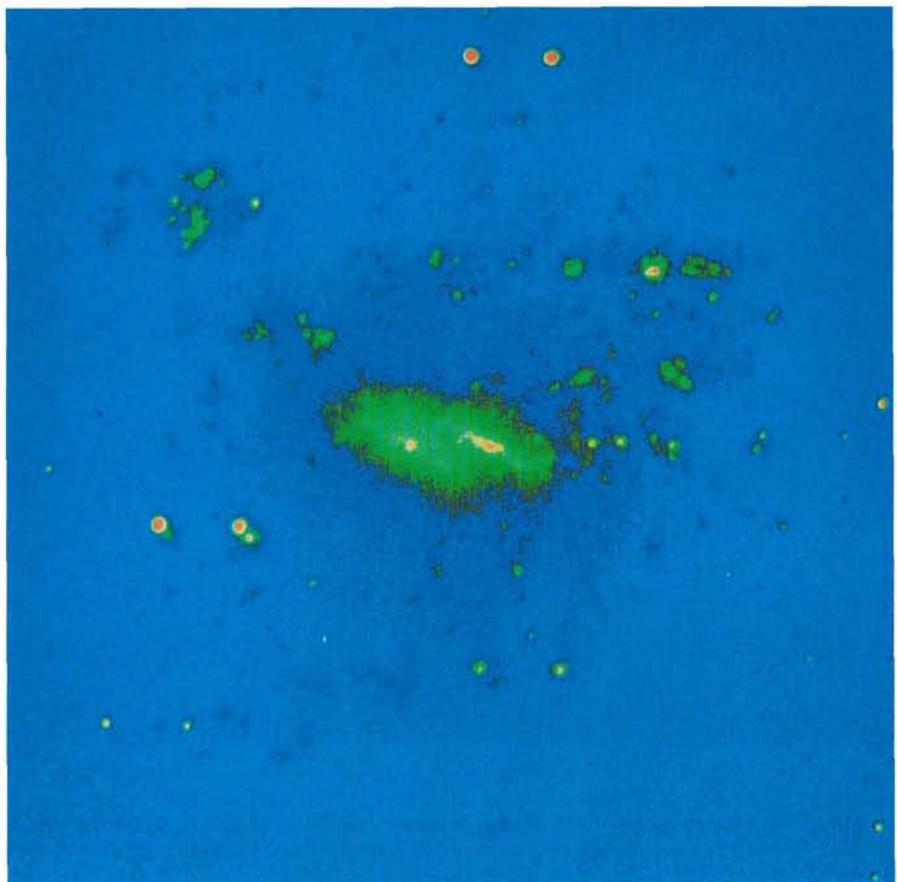


Figure 1: Detection of at least three regions with intense star formation in a spiral galaxy. A combination of two exposures with the 1-metre ESO Schmidt telescope on IIIa-F emulsion: UV (80 min. behind a UG 1 filter) and R (25 min. behind a RG 630 filter). The upper images belong to the R exposure and the lower to the UV exposure; the offset is 30". It can be seen that the lower (southern) UV images of the star-forming regions are significantly brighter than the R images. Digitized with MAMA for a programme conducted by G. Comte (Observatoire de Marseille). Plate 7922 obtained on March 13, 1989.

pixel size (and sampling step) is 10  $\mu\text{m}$ . Oversampling down to 2  $\mu\text{m}$  can be used to digitize spectra; for some applications, pixels of 20, 30...80  $\mu\text{m}$  can be synthesized in real time.

The digitized images can be processed according to three main modes. On-line processing leads, through a multilevel thresholding technique, to a catalogue of positions, areas, fluxes and second-order moments. Off-line processing is possible on the site using DEC-3100 or SUN SPARC 2 workstations, and a VAX 8250 computer; the available software includes MIDAS and a number of tools specially designed to extract the best from the astrometric and photometric capabilities of the machine. Finally, the user can of course take the pixels with him to process them with his own facilities.

A wide variety of scientific projects are currently being carried out using MAMA. Several long-term programmes dealing with solar physics are based on spectral images from Pic du Midi, Teide Observatory (Tenerife), Sacramento Peak, and Meudon where spectroheliograms have been accumulated since the beginning of this century. Works concerning the solar system,

stellar populations and galactic structure as well as extragalactic astronomy are mainly based on Schmidt plates from Palomar, Siding Springs, Calar

Alto, Tautenburg, CERGA, and of course ESO.

Galactic structure surveys conducted with MAMA take advantage of the astrometric accuracy of the machine. Using plates taken over 40 years, relative proper motions are obtained by C. Soubiran (1991) for high numbers of stars with an accuracy of 1.5 milli-arc-sec/year, which compares favourably with the absolute accuracy of HIPPARCOS. This geometric accuracy of MAMA is also quite appreciable when reducing objective-prism images, since the quality of radial velocity determination strongly depends on the geometry of the measuring machine.

The photometric accuracy allows stellar magnitudes to be determined to within 0.05 mag., provided good sequences are available. This feature is of course interesting for the study of stellar populations as well as for extragalactic programmes. Among the latter, an extensive search for quasar candidates mainly based on multicolour photometry in the North Galactic Pole region; Schmidt plates taken at various epochs will also be used to investigate the variability of the detected galactic and extragalactic objects. Information about MAMA and reduction techniques can be found in the papers by Berger et al. (1991) (see also the paper by Guibert et al. (1990), and references therein).

Among the programmes currently on the way which are based on La Silla instruments let us quote an extensive project aimed at the search for baryonic dark matter in the Galactic halo. The technique consists in monitoring the magnitude of a large number of stars of

## SCIENTIFIC ASSOCIATE

A position as Scientific Associate will shortly be available in the Science Division's Astronomy Group at ESO Headquarters in Garching bei München for an astronomer with a Ph.D. degree or equivalent and several years of post-doctoral experience.

This is a senior position in the group, and the successful applicant will be expected to carry out an active research programme and to contribute significantly to the activities and responsibilities of the group. Scientific interests in the Astronomy Group include large-scale structure; quasars; AGNs; dynamics and chemical evolution of galaxies; supernovae and supernova remnants; variability of early-type stars; and the diffuse interstellar medium. In all areas emphasis is placed on high-quality data and its interpretation. Responsibilities include the guidance of students and junior fellows, the workshop and symposium programme, assistance to visiting astronomers using ESO's data reduction and remote observing facilities, and interaction with other groups at ESO Headquarters in matters ranging from telescopes and instrumentation to computing and image processing.

This position will be awarded initially for a period of one year, and may be renewed by one year or more to a maximum of six years. Applications should be submitted as soon as possible. Application forms can be obtained from:

European Southern Observatory  
Personnel Administration and General Services  
Karl-Schwarzschild-Str. 2  
D-8046 Garching bei München  
Germany

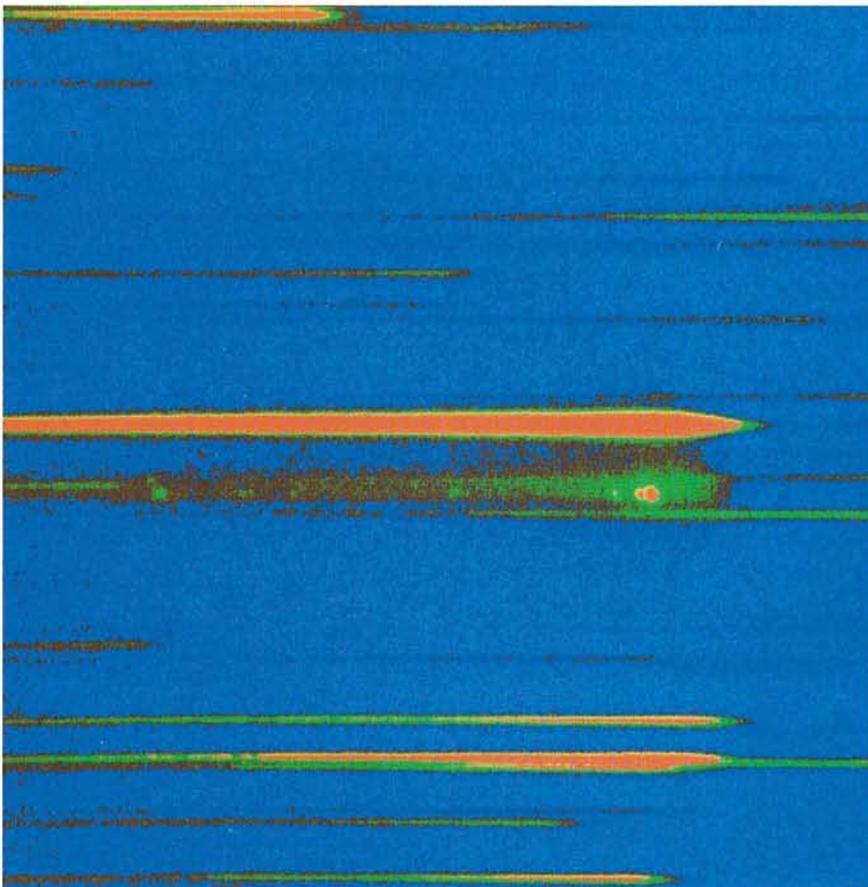


Figure 2: Strong emission in the objective-prism spectrum of a galaxy, indicating intense star formation. The plate (no. 7906) was obtained on March 6, 1989 with the ESO 1-metre Schmidt telescope, equipped with a 4° UBK7 prism; dispersion 450  $\text{\AA}/\text{mm}$  at 4350  $\text{\AA}$  and 750  $\text{\AA}/\text{mm}$  at 5000  $\text{\AA}$ . Exposure: 100 minutes on IIIa-J emulsion without filtre. Digitized with MAMA for a programme conducted by G. Comte (Observatoire de Marseille).

the LMC, the light of which could be amplified by microlensing when passing close to small and massive halo objects, such as jupiters, brown dwarfs, or small black holes. The ESO Schmidt telescope is used to search for deflectors with masses in the range  $10^{-1} - 10^{-4}$  solar masses; a companion programme, using an assembly of CCD detectors, is aimed at the detection of masses in the  $10^{-4} - 10^{-6}$  solar masses range. In the galactic domain, we can also mention stellar-population studies and star counts.

In the extragalactic field, direct and objective-prism plates from the La Silla Schmidt telescope are, among others, used to detect and study galaxies with bursts of star formation. This will be the topic of a paper by G. Comte (Observatoire de Marseille) in a forthcoming issue of *The Messenger*, and is illustrated by two photographs accompanying this presentation. The first concerns a direct double U-R exposure; the second reproduces part of an objective-prism plate.

In planetology, we can mention, among others, the study of Neptune's arc rings through accurate trajectography of the planet and Triton, performed on Schmidt plates from La Silla.

Glass copies of both ESO-R and SERC-J surveys are available in the plate vault: they are extensively used for preparing observations with the La Silla instruments, as well as for the identification, astrometry and photometry of optical counterparts of sources detected at other wavelengths: radio, X, infrared. In particular, MAMA is being used for identification and photometry of faint IRAS extragalactic sources.

We have given some examples of the invaluable role of photographic material taken at different epochs in studies of proper motions as well as variability in solar, galactic and extragalactic astronomy. In addition, ground-based and space observations at various wavelengths require and will continue to require wide-field complementary investigations.

The TYCHO catalogue will contain about one million stars known to a few hundredths of a second of arc and a few hundredths of a magnitude. This will result in significant improvement of the calibration of Schmidt plates which are expected to remain, for a long time, irreplaceable supports for wide-field information.

### References

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- Soubiran, C., 1991, *Astron. Astrophys.*, in preparation.

Access to MAMA: MAMA is available for visitor use.

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## MIDAS Memo

### ESO Image Processing Group

#### 1. Application Developments

The Echelle package has been further upgraded with instrument independent wavelength calibration and better background correction.

Peter Stetson has implemented a new version of DAOPHOT during a visit to ESO in April. This version reads the image data directly from the MIDAS .bdf files. An interface between DAOPHOT and MIDAS enables exchange of the table data between the two systems and thereby makes DAOPHOT available for MIDAS users. The DAOPHOT package and the interface are not on the standard release tape of the 91MAY version but can be obtained on explicit request to ESO.

A set of adaptive filters based on the Haar transform was installed in MIDAS by Gotthard Richter. These filters are especially useful for surface photometry applications since they smooth selectively areas depending on the local gradient. They are available in the 91MAY release of MIDAS.

#### 2. ESO-MIDAS Courier

The Image Processing Group will start a biannual newsletter on MIDAS-related matters. It is called the ESO-MIDAS Courier and is edited by Rein Warmels. It will contain significantly more detailed information than has been possible in the MIDAS Memo. Contributions to the Courier can be sent to the MIDAS E-mail address, attn.: MIDAS Courier.

#### 3. Data Analysis Workshop

The 3<sup>rd</sup> annual ESO/ST-ECF Data Analysis Workshop took place April 22-24 in the ESO Headquarters. It consisted of 1½ day scientific meeting centred on reduction software for direct image data followed by one day with users' meetings for both MIDAS and ST-ECF. Approximately 90 people participated in the meeting where more than

### Central Computer Facilities of ESO

The central computers of ESO, which now consist of a cluster of two VAX 8600 systems running the VAX/VMS operating system, will be replaced during the fall of 1991. The new systems will use the UNIX operating system and support the X11 window system. A small VAX/VMS system will be purchased to ensure compatibility with external sites using VAX/VMS systems. UNIX workstations are expected to replace the DeAnza image display systems now connected to the VAX's.

The electronic network connections to SPAN, Internet, BITNET/EARN and UUCP will be maintained whereas the VMS/PSI-mail option will be discontinued. Direct access to ESO through X.25 and modems will still be possible. After the exchange of computer systems, it is expected that electronic News, Bulletin Boards and anonymous ftp accounts will be made available to facilitate easy information exchange between ESO and its user community.

P. GROSBØL, ESO