material. Therefore the results obtained so far are still preliminary, however, it is obvious already that BD Pav has raised from a black dot on a plate in 1934 to an important star among the CVs.

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SUMMER SCHOOL ON

"OBSERVING WITH LARGE TELESCOPES"

ESO and the Astronomical Council of the Academy of Sciences of the U.S.S.R. will organize a summer school during the period 21–30 September 1987 at the Byurakan Observatory near Erevan on the subject "Observing With Large Telescopes". A limited number of advanced predoctoral or recent postdoctoral participants from the ESO member countries will be invited to attend. Persons interested in participating should apply before 15 April 1987 to: Office of the Director General, ESO, Karl-Schwarzschild-Str. 2, D-8046 Garching b. München.

Applicants should give their main biographical data, passport number (incl. date and place of issue), a brief account of their scientific work and a list of publications. A letter of recommendation from their (thesis) supervisor should also be included.

Strengthening Research Links Between Astronomy/Astrophysics and Computing/Statistics

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In this article, a few current research directions are discussed, which relate to the common interfaces between astronomy/astrophysics, computer science and statistics. They relate essentially to organizational matters (working groups, conferences). Within the next decade contact between researchers over computer networks will become increasingly trouble-free, but for the present, contact between widely scattered researchers (and especially among those who straddle traditional disciplines) is necessarily in hard-copy form, as for example in this journal!

– Multivariate data analysis could be viewed as mid-way between statistics and graphics, and is an important part of the armoury of methods and tools available to the astronomer. Work to date in astronomy and astrophysics, using multivariate methods, has been surveyed (see Murtagh and Heck, 1986), and a text-book motivating methods, detailing the mathematics, and enumerating case-studies has recently become available (Murtagh and Heck, 1987).

– A working group was set up in 1985 to further contact between researchers with an interest in this, and related fields. It is the *Working Group for Modern Astronomical Methodology,* with a current active membership of a little under 100 worldwide. A bulletin is published twice yearly, and is currently contained in the *Bulletin d'Information du Centre de Données de Strasbourg* (C.D.S., Observatoire de Strasbourg, France). Further details may be obtained from André Heck or from Fionn Murtagh.

– Faced with ever-greater concentrations of astronomical data, new approaches to data handling and analysis need to be discussed and perfected. Recent years have seen the well-known workshops held at the Ettore Majorana Centre in Erice, Sicily (Di Gesù et al., 1984; 1986). The next workshop in the Erice series *(IIIrd International Workshop on Data Analysis in Astronomy)* will be held in June 1988. It will address advanced and unconventional data analysis methodologies; knowledge based systems; and parallel algorithms for data analysis. The use of fuzzy techniques and possibility theory is also an on-going topic of relevance, for low-statistics image data.

– A conference entitled *Astronomy from Large Databases: Scientific Objectives and Methodological Approaches* will be hosted by the ST-ECF in Garching on 12–14 October 1987. It functions as a follow-up conference to one entitled *Statistical Methods in Astronomy* which was held in Strasbourg in 1983 (see Rolfe, 1983), and additionally addresses the topic of centralized data collections which are becoming increasingly important. The proceedings of this conference will be published by ESO.

– While it is important to focus efforts among astronomers and astrophysicists in order to tackle new problems in innovative ways, it is also important to mobilize computer scientists to bring increased efforts to bear on astronomical problems. A trend of relevance in recent years has been the increasing number of astronomical studies published in the mainstream pattern recognition literature. One important organ, internationally, in computing is the *International Association for Pattern Recognition* (IAPR). It is concerned with pattern recognition and image processing in a broad sense. It organizes major biennial conferences (the most recent in Paris in October 1986 had about 900 attendees), sponsors the journal *Pattern Recognition Letters,* and publishes a newsletter. Membership in the IAPR is by way of the relevant national pattern recognition or computing organization. The IAPR has a number of Technical Committees active in various fields of activity, and such a Technical Committee has recently been set up for astronomy and

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astrophysics. Further details may be obtained from Vito Di Gesù or from Fionn Murtagh.

The foregoing trends serve to illustrate how "computational astronomy" has now become solidly established as a subdiscipline of importance in astronomy and astrophysics, closely following in the footsteps of its sister-subdiscipline, image processing.

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5. E.J. Rolfe (ed.) (1983): *Statistical Methods in Astronomy,* European Space Agency Special Publication 201 (270 pp.).

A conference, hosted by the Space Telescope – European Coordinating Facility, on

Astronomy from Large Databases: Scientific Objectives and Methodological Approaches

will be held in Garching from 12 to 14 October 1987.

Topics will include statistical analysis of complex databases, object classification problems, astrophysics from large data collections, together with state of the art reviews of astronomical database technology and expert system applications.

The Proceedings will be published by ESO.

Further information may be obtained from F. Murtagh, ST-ECF, ESO, Karl-Schwarzschild-Str. 2, D-8046 Garching bei München, FRG.

Crowded Field Photometry Using EFOSC and ROMAFOT

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EFOSC

The ESO Faint Object Spectrograph and Camera (EFOSC), instrument of the ESO 3.6-m telescope, can be used as a very efficient CCD camera for wide-band photometry of crowded stellar fields. EFOSC was designed to match the RCA SID 501 EX CCD (320 × 512 pixels, 30 × 30 microns pixel size). Each pixel corresponds to 0.675 arcsec and the total field of view is 3.6 × 4.7 arcminutes (1). Using the instrument in direct imaging mode, the limiting magnitude of a 15 minute exposure with seeing of FWHM = 1.3 arcseconds in the V band is about 25.5 for a signal-to-noise ratio of 3 (2).

A typical EFOSC field of the Small Magellanic Cloud will yield hundreds to thousands of stars in less than five minutes! In good seeing conditions the central cores of star images will be partially undersampled due to the 0.675 arcsecond per pixel scale. The combination of crowded stellar fields with partially undersampled data presents a challenge to the astronomer who wishes to do accurate stellar photometry with EFOSC data.

DAOPHOT

In March 1986 I visited ESO Garching to see if the photometric reduction package DAOPHOT (3) was suitable for use with EFOSC data and CCD data from the ESO 2.2-m telescope. Using both real and artificial data, I found DAOPHOT to be potentially useful for the 2.2-m data (0.35 arcsecond per pixel) and totally inadequate for the less well sampled EFOSC data (0.675 arcsecond per pixel). The results of this trial experiment do not bode well for the ability of DAOPHOT to work adequately with data from the Hubble Space Telescope.

ELIA

ELIA (4) was developed at the Observatory of Rome specifically to do photometric reduction in crowded stellar fields – in particular globular clusters. I visited the Observatory of Rome in October 1985 and reduced some EFOSC images of an extremely crowded field in the SMC. Although the image was quite complex, ELIA made excellent fits to over 1,400 stars. ELIA employs a non-linear least squares fitting algorithm which was found to be remarkably successful at ignoring cosmic rays and other image defects.

ROMAFOT and the Personal Astronomical Work Station

At the Rome Observatory, ELIA serves as a complete image processing system. Thus there are programmes to read and write FITS tapes, programmes to flat-field images, programmes to plot data, etc. By using the ESO Munich Image Data Analysis System (MIDAS) as my main image processing system, I only needed to use the few programmes which actually did photometric reduction. I have converted these programmes to run on VAX computers and have renamed the package ROMAFOT.

I have also written a C language programme "Personal Astronomical Work Station" (PAWS) which effectively transforms a standard Commodore Amiga personal computer into a complete MIDAS work station consisting of emulations for (1) a VT-100 terminal, (2) a HP graphics terminal and (3) a DeAnza image display. By replacing the Tektronix terminal that ELIA previously required with an Amiga running PAWS, I have been able to substantially improve the performance of ROMAFOT. By judiciously using coloured images (instead of shades of green), ROMAFOT has been improved to make it easier for the user to quickly produce more accurate results. The combination of ROMAFOT with MIDAS provides the astronomer with a very powerful tool to do accurate photometric reduction of crowded stellar fields.

ROMAFOT/MIDAS Features and Abilities

- Reads FITS tapes
- Automatic location of most stars on a CCD image