Table 1: *Relative abundances*

[Fe/H]	=	−3.13
[Mg/Fe]	=	+0.59
[Al/Fe]	=	−0.82
[Si/Fe]	=	+0.50
[Ca/Fe]	=	+0.50
[Ti/Fe]	=	+0.38
[Cr/Fe]	=	−0.18
[Sr/Fe]	=	−0.22
[Ba/Fe]	=	−0.62

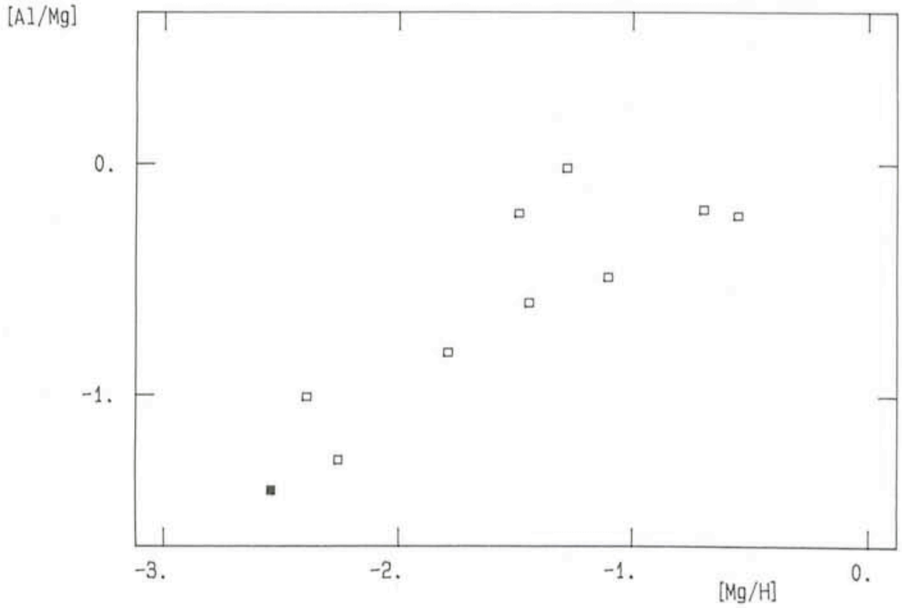

Figure 3: *Plot of [Al/Mg] versus [Mg/H] for the stars of Magain (1987, open squares) and for BD +03°740 (full square).*

1981) with [Fe/H] = −4.5 and the turnoff star G 64−12 (Carney and Peterson, 1981) for which [Fe/H] = −3.5. Incidentally, BD +03°740 is also probably a star near the turnoff. The relative abundances confirm the general picture outlined in Magain (1985, 1987) and other papers, namely:

– overabundance of the "α elements" Mg, Si, Ca and Ti by some 0.5 dex,

– overdeficiency of the s elements Sr and Ba,

– large overdeficiency of Al relative to Mg: [Al/Mg] = −1.4.

The behaviour of Al relative to Mg is subject to some controversy, some authors (e.g. François, 1986) suggesting that [Al/Mg] is constant in the halo, at roughly −0.5, while others (e.g. Arpigny and Magain, 1983; Magain, 1987) argue in favour of an increasing Al overdeficiency with decreasing metal abundance. The present analysis supports this last interpretation, as is shown in Figure 3, where the representative point of BD +03°740 is added to the [Al/Mg] versus [Mg/H] plot of Magain (1987). It should be pointed out, however, that the Al abundance in the most extreme metal-poor stars is determined from the single resonance line at 3961 Å. and would be in error if the latter was affected by departures from LTE.

Finally, the analysis of BD +03°740, which is the most metal-poor dwarf in which s element abundances have been determined, confirms the presence of these secondary elements in the atmospheres of the extreme halo dwarfs, in contradiction with the classical models of nucleosynthesis and galactic evolution.

Acknowledgements

I wish to thank T. Le Bertre and H. Lindgren for providing me some infrared and visual photometry of this star.

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BD Pavonis, a New Double Lined Eclipsing Cataclysmic Binary

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Cataclysmic binaries are double stars consisting of a compact primary and a cool secondary component. They are so close that the surface of the secondary fills its so-called Roche limit and transfers matter towards the primary in a stream. Due to the system's orbital motion, however, the stream does not impact on the primary but forms an accretion disk around it. Where the overflowing mass hits the rotating gas, a hot bright spot is produced. The momentum of the disk material has to be separated before it can be accreted onto the primary. Magnetic fields can influence the structure of the disk, in some cases no disk exists at all and matter is forced to flow along the magnetic field lines producing extremely hot X-ray emitting spots above the magnetic poles.

Novae, dwarf novae, several X-ray sources like AM Her stars, intermediate polars, DQ Her stars and X-ray bursters are examples for the large group of CVs, and the variety of classes demonstrates their complex behaviour.

A unique member of this group, BD Pav, had been discovered by Boyd (1939) on star plates taken in 1934. The object, never seen before, suddenly had brightened to 12.4 mag. After 20 days the star faded below detection limit (16.5 mag) again. This led to the classification as a classical nova, which was doubted already by Payne Gaposchkin (1977) because of consequences of the decay time scale on the absolute magnitude.

We observed BD Pav with the ESO 1.5-m telescope in June 1980 during a spectroscopic survey programme searching for cataclysmic systems with

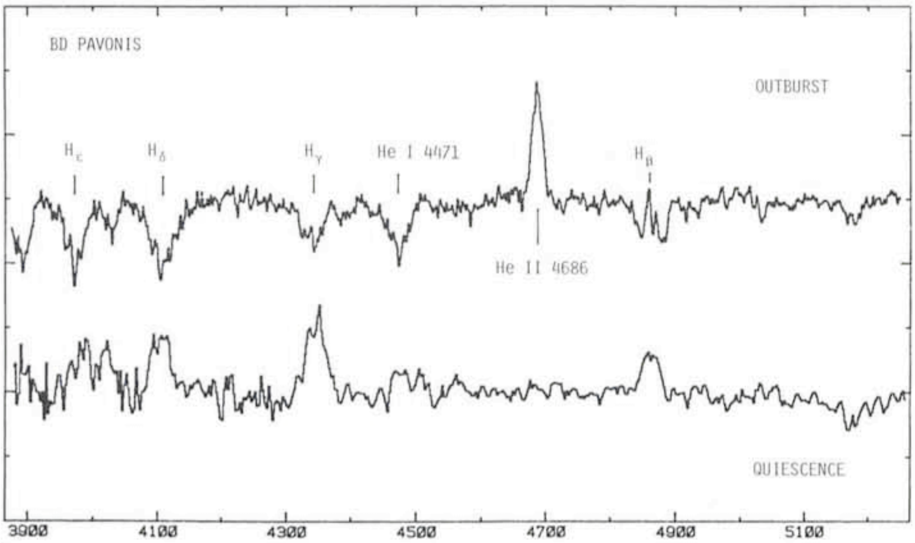

Figure 1: *Averaged spectra of BD Pavonis during eruption and in quiescence. The outburst spectra (upper part) were taken at the ESO 3.6-m telescope with the B & C and CCD in 1985. Strong broad absorption lines of H and HeI 4471 are shown together with HeII 4686 in emission. The spectra in quiescence state (lower part), obtained with the 2.2-m telescope in 1986 mainly show the Balmer lines in emission.*

high orbital inclination, i.e. with broad and double peaked emission lines. Due to its spectrum BD Pav was selected for further investigation.

Photometric light curves revealed strong flickering and eclipse like features (H. Barwig, R. Schoembs, 1981). The data had been seriously affected by variable extinction however. Since the object is well observable only during the season around June, known for its unfavourable weather conditions, several attempts to complete the observational material had to be made. A first analysis of the object was based on data obtained at La Silla in 1980 and 1981 (H. Barwig and R. Schoembs, 1983). This paper reported the orbital period (P = 4.3 hours), the existence of a primary eclipse and strong effects from ellipsoidal distortion of the Roche lobe filling component. The secondary turned out to be unusually luminous. The complex double peaked emission line profiles were difficult to measure. Radial velocity variations of 600 km/s were determined by means of correlation techniques. These results considerably increased the interest on BD Pav. A further proposal for photometric observations in 1982, granted with 9 nights at the Walraven Photometer, was totally impeded by terrible weather. It was that period when a blizzard at La Silla stopped all astronomical activities.

Discussions on the most appropriate observing techniques convinced us that we would need a larger telescope for spectroscopy and a photometer totally different from classical single-channel instruments for observation of BD Pav and many other variable objects. Although at some other institutes first developments had started, a photometer with increased efficiency and time resolution, i.e. with simultaneous UBVRI capability and much lower sensitivity to variable extinction was not available to us. Since our photometric programmes at other sites were also affected by poor weather conditions, the decision to construct our own appropriate photometric equipement was taken in 1982. The new system allowed to measure three sources (object, nearby comparison star and sky background) in five colours (UBVRI), all simultaneously and with high time resolution (Barwig et al., 1987). The instrument had been used at La Silla for the first time in 1983 (Schoembs et al., 1987) and for BD Pav in 1985.

Additionally, during the same observing period, two nights at the 3.6-m telescope had also been allotted to spectroscopy. When observations started, BD Pav appeared surprisingly bright on the TV screen, a phenomenon which first was attributed to its red colour, but when the first spectrum was displayed showing broad Balmer absorption lines instead of emissions, it became obvious that the object was caught during an eruption. This outburst is the first one known to us since discovery. It immediately confirmed our suggestion that BD Pav rather is a dwarf nova than a classical nova. Although it was great luck to encounter this outburst, we knew that because of the dominant radiation from the accretion disk during this active phase, there would hardly be a chance to find spectral features of the secondary, one important aim of our mission. Detection of the secondary spectrum in cataclysmic binaries is of fundamental importance. In that case much more reliable system parameters can be derived than from radial velocities of the emission or absorption lines originating in the complex primary accretion disk configuration. Typical spectra of BD Pav during outburst and quiescence are displayed in Figure 1 for comparison.

Immediately after the spectroscopic run, photometric observations at the 1-m telescope started for 8 nights. We were curious of the first light curve, in

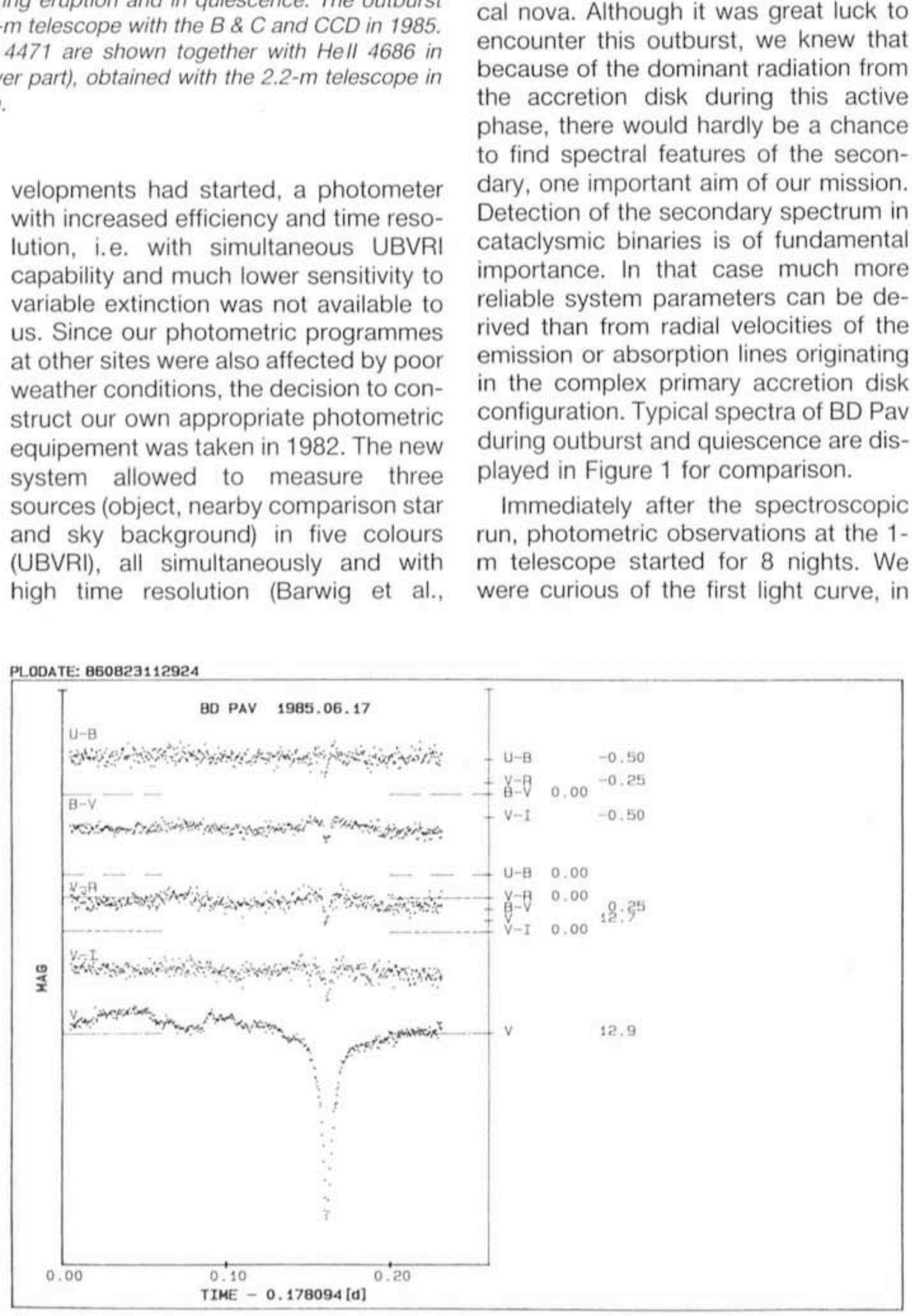

Figure 2: *UBVRI light curves of BD Pavonis during eruption taken in the first observing night at the ESO 1-m telescope with the multichannel photometer. The deep eclipse of a small blue primary and disk is shown and a shallow minimum of a larger redder object at orbital phase 0.5.*

particular whether the eclipse feature visible during quiescent state would have disappeared or still exist. The latter case would mean that the orbital inclination is so large that even the bright central accretion disk, the main source of radiation during eruption, is eclipsed. Somewhat less than one orbital period after beginning of observation, when we already thought that the eclipse had disappeared, the intensity curve on the graphic screen suddenly began to drop while the comparison star stayed constant, indicating that no clouds were coming up. Some 20 minutes later the light curve had returned to its original level.

The reduced light curves of this night are displayed in Figure 2 while Figure 3 shows BD Pav during the last night of our observing period, when the star had almost reached its normal brightness. Figure 4 shows the recorded count-rates of sky and comparison star for all nights. Cloudy skies yield comparison star counts ranging between their normal values and the sky counts, while clear nights only show the expected dependency on zenith distance superposed by sky brightness variations (most pronounced in U during moon set at beginning of nights 7 and 8).

It is found that atmospheric transparency changes up to 80 % can be compensated applying the differential

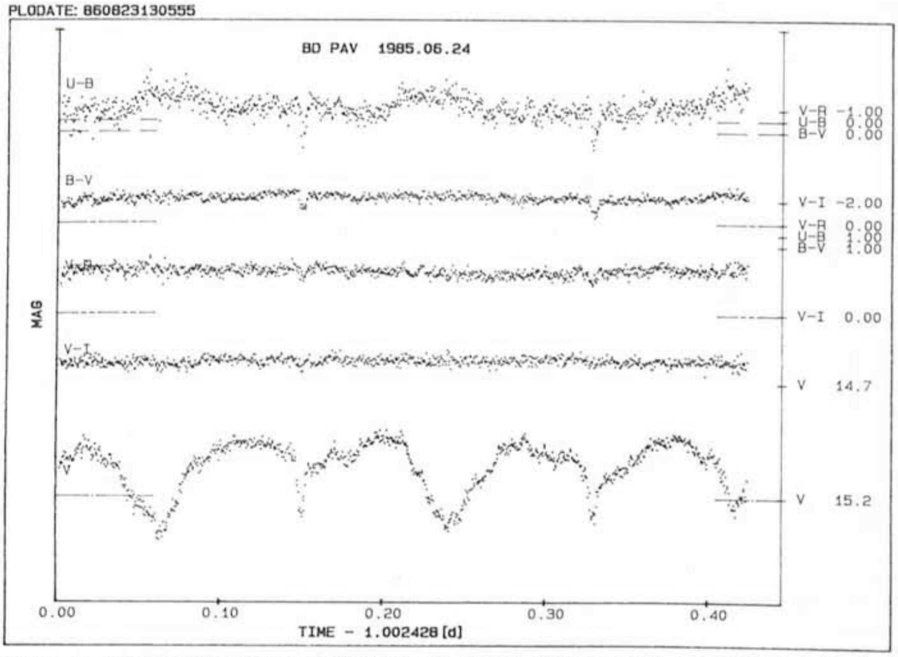

Figure 3: *UBVRI light curves of BD Pavonis at the end of eruption, obtained in the last observing night.*

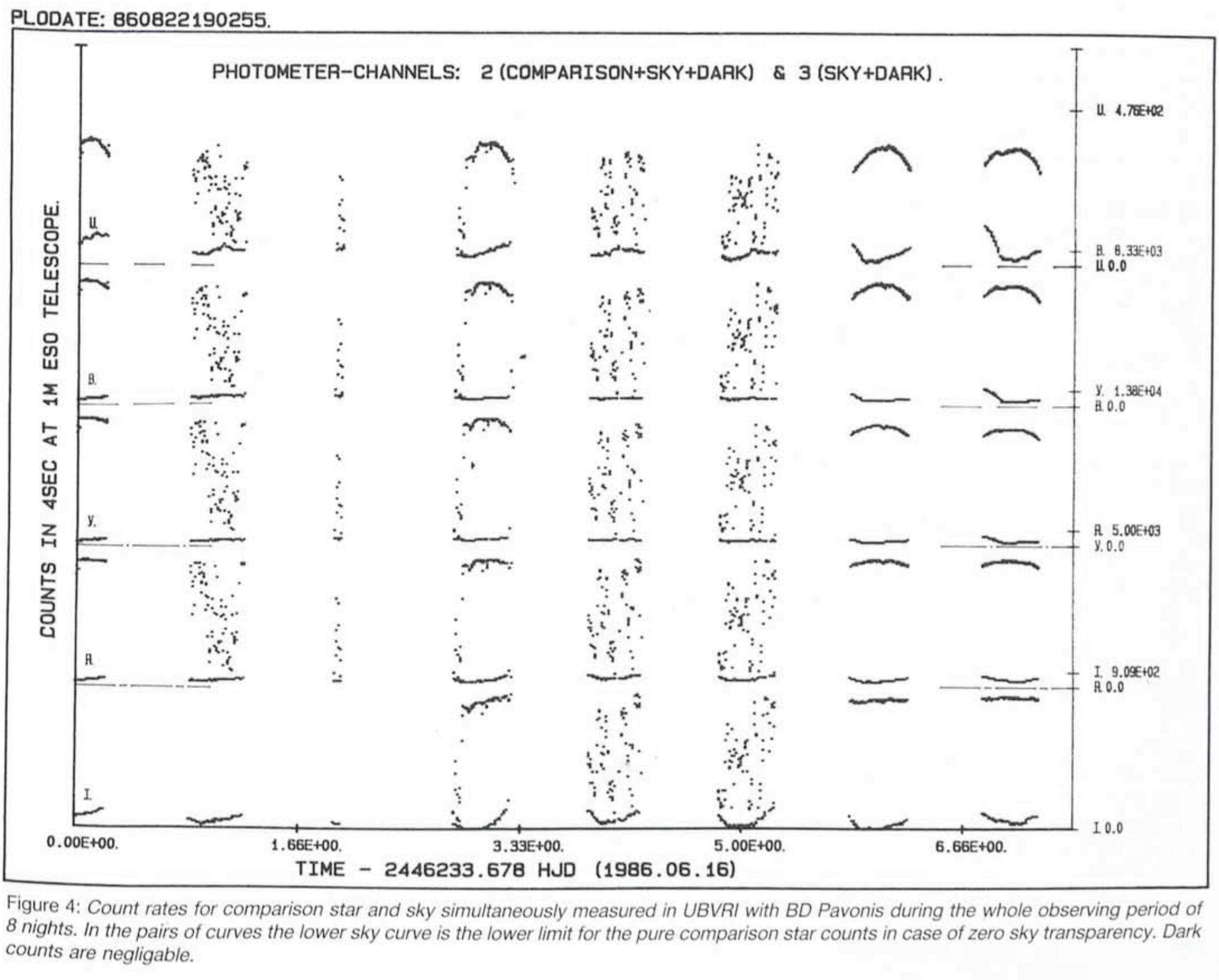

Figure 4: *Count rates for comparison star and sky simultaneously measured in UBVRI with BD Pavonis during the whole observing period of 8 nights. In the pairs of curves the lower sky curve is the lower limit for the pure comparison star counts in case of zero sky transparency. Dark counts are negligable.*

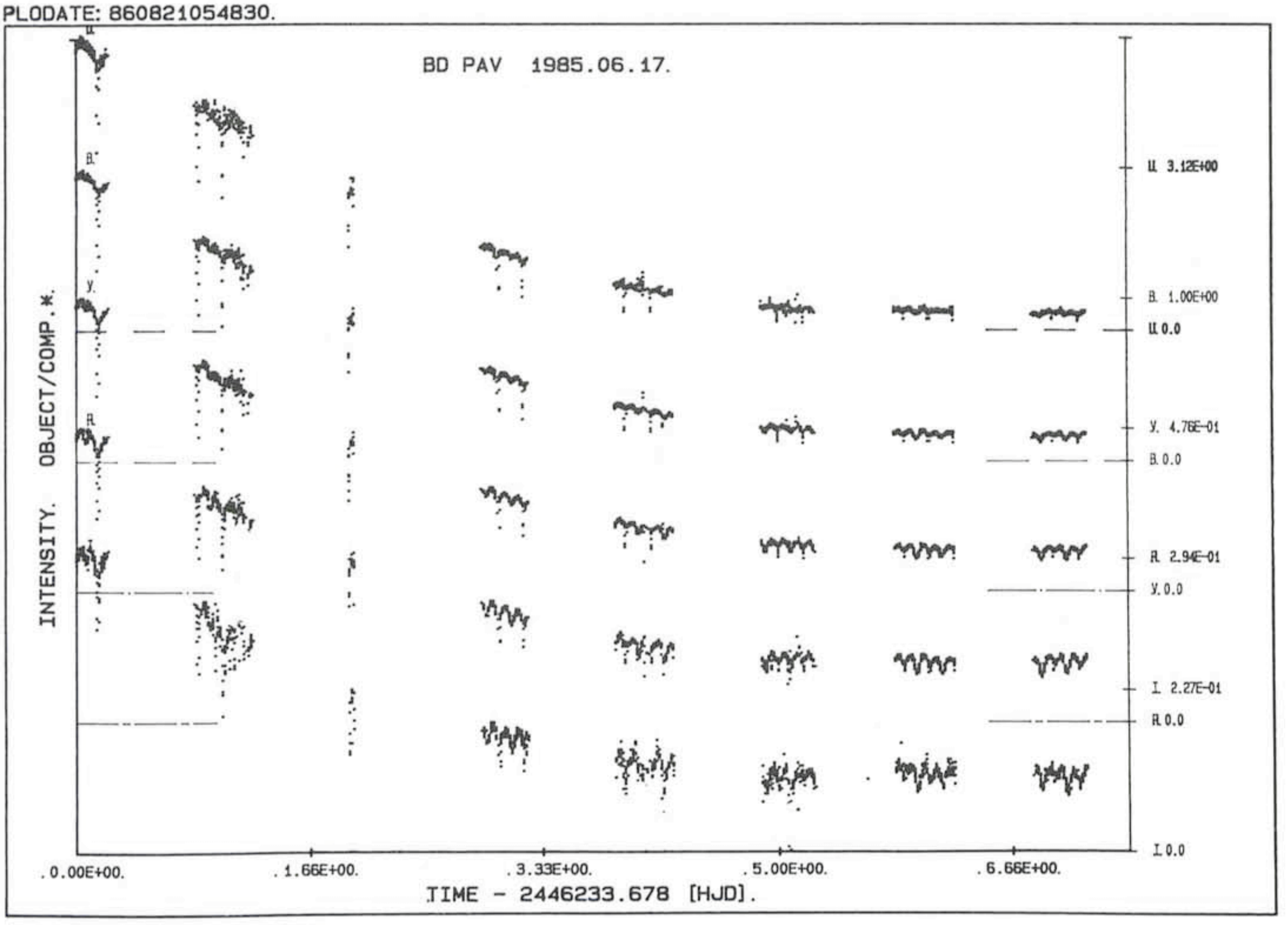

Figure 5: *The UBVRI intensity variations of BD Pavonis during decay from the eruption in 1985. Condensed representation.*

measuring methode. Condensed light curves in Figure 5 reveal the behaviour of the intensities relative to the comparison during decay from eruption. During bright phases the primary eclipse is a prominent feature deeper at shorter wavelengths. Its relative minimum depth stays fairly constant throughout decay. There is a secondary minimum around phase 0.5 shown in Figures 2 and 3, which is stronger in the red. During the first two nights this minimum has an eclipse-like shape with sharp edges and flat bottoms. Later on it rather resembles variations caused by ellipsoidal distortion of the secondary. Again we found strong evidence for an unusual bright secondary which encouraged the attempt to obtain spectra during quiescence in order to detect the spectrum of the secondary.

Such spectra could be obtained with the ESO 2.2-m telescope in 1986. While observing, the 74 CCD spectra were sequentially arranged after each exposure into a two-dimensional frame displayed on the RAMTEK screen. Among the well-known emission line system of the primary disk configuration suddenly after a few integrations faint absorption lines could be recognized to follow a sine like curve complementary to the emission lines (Fig. 6). – The secondary component had been detected! – The outburst spectra of 1985 had of course also been carefully checked earlier by plotting all traces in a single figure but no definite evidence for the companion star could be found. In the last weeks, a revision of the same spectra using the identical technique as in Fig. 6, revealed the secondary component as well. A period analysis of the radial velocity variation yielded the photometric period.

In order to derive accurate system parameters from the observational data, several effects have to be taken into account as for example the non spherical shape and temperature distribution of the secondary and the distortion of the emission lines due to the complex velocity distribution of the line emitting

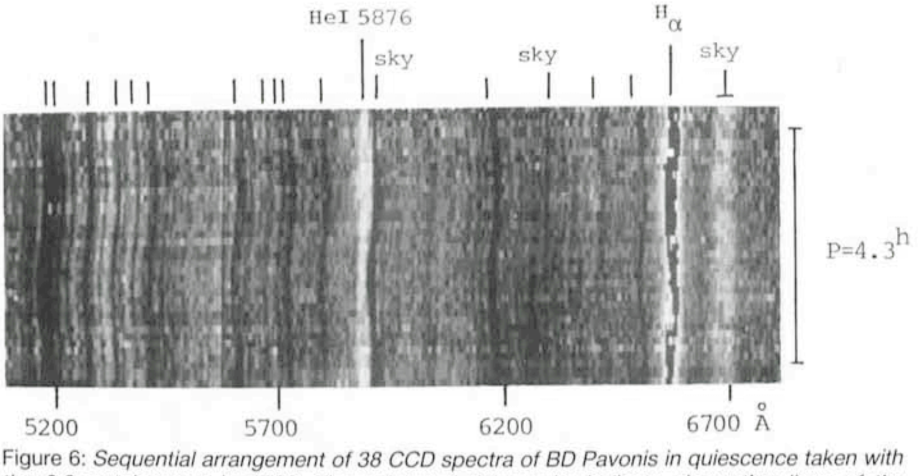

Figure 6: *Sequential arrangement of 38 CCD spectra of BD Pavonis in quiescence taken with the 2.2-m telescope in 1986. The unlabeled tick marks indicate absorption lines of the secondary showing a sine like radial velocity variation.*

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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