Long-term Photometry of Variables at La Silla

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Many visiting astronomers at ESO are involved in the study of stellar variability on long time-scales (supergiants, Ap stars, pre-main-sequence stars...). Real "monitoring" of variables during a time-span of several years is almost impossible because allotted observing runs are too short and not continuous. The long gaps between the visits of an individual observer inevitably affect the homogeneity of the results (e.g. effects of changes in the instrumental system). A possible solution towards a more successful study of long-period variables is to select a restricted number of interesting objects of different type, and to observe them in an almost continuous way throughout succeeding observing seasons. Such an observing programme evidently calls for international collaboration in a well-organized team.

Early in 1982 such a programme was initiated by a dozen observers belonging to several European institutes. A number of individual observing programmes were merged and grouped into several separate research topics, and for each topic a principal investigator and a co-investigator were appointed. The following topics were selected:

		Main investigator	Co-investigator
1.	Pre-main sequence stars	P. S. Thé	H. Tjin A Djie
2.	Ap stars	H. Hensberge	J. Manfroid
3.	Eclipsing binaries	H. Duerbeck	A. van Genderen
4.	Be stars	D. Baade	A. Bruch
5.	Supergiants	B. Wolf	M. de Groot
6.	X-ray sources	M. Burger	M. Pakull
7.	Events of opportunity	C. Sterken	

The last category consists of objects which need immediate monitoring due to the occurrence of an unexpected event (flares or bursts) or due to exceptional observational possibilities (e.g. simultaneous ground-based and space observations). Other topics may be added if necessary. The principal investigator selects objects which are suitable for observation, and the central coordinator (C. Sterken) finally submits the application to ESO.

The actual list of objects contains about 120 stars with right ascensions between 6 hours and 24 hours. About 50 % of them must be observed at a frequency of one measurement per night throughout the observing season. The frequency for observing the remaining stars ranges between one measurement every second day to one or two measurements per month.

It is obvious that only for the smaller telescopes one may hope to obtain sufficient observing time. The participants have expressed a strong interest in the use of the Strömgren uvby photometric system. This is the only photometric system which can be used at the Bochum 61 cm, the ESO 50 cm and the Danish 50 cm telescopes. The combination of an intermediate bandwidth filter system and a telescope of modest aperture obviously puts some constraints on the limiting magnitude of the selected objects, but the advantage of the Strömgren system in terms of physical interpretations is extremely important, and since the main emphasis of the programme is the long-term character, the uvby system was adopted.

Starting in October 1982, seven observing runs have already been granted. Each run has a typical length of about three to four weeks. The observers are participants who volunteer to carry out the measurements according to the adopted observing scheme.

All measurements are obtained in a differential way using two comparison stars for every programme star. Standard

stars are observed each night, so that the measurements can be transformed to the standard uvby system.

All measurements are reduced by J. Manfroid (Institut d'Astrophysique, Université de Liège). Before leaving La Silla, the observer sends the magnetic tape with the measurements to Liège. Experience has shown that the reduction takes about two weeks, so that the principal investigator receives the results about one month after termination of the observing run.

This fast processing of the data has proven to be extremely useful, especially in those cases where unexpected changes in the light curves of one of the objects calls for immediate action (a flare-like event in the light curve of FU Ori was observed by D. Vander Linden in February 1983, and on request of H. Tjin A Djie the object was reobserved intensively during the next observing run). Another advantage is that instrumental deficiencies (e.g. deteriorated filters, wrong alignment . . .) are detected at once, and can be cured immediately.

The responsibility for the scientific value of the subprogramme rests entirely with the principal investigator; he also redistributes the final data belonging to his section. About once a year the available data will be published in *Astronomy and Astrophysics Supplement Series;* the author list of that paper will consist of the names of all observers who have contributed to these published measurements, and of the persons who carried out the reductions. The interpretation of the results and the scientific discussion are carried out by those persons who applied for the measurements.

Some interesting results are already available after this first full year of operation.

For several Ap stars, improved periods (in the range of 1 to 4 days) were obtained.

Nine pre-main-sequence stars have been monitored so far. The range of variation in y decreases for earlier spectral types, and significant night-to-night variations are found in some cases. The data for UX Ori and CD-4403318 were used together with IUE spectra for a discussion of their evolutionary status (H. Tjin A Djie, L. Remijn, P. S. Thé, 1983, in preparation).

About 200 uvby observations of a number of Be stars were obtained. HR 2142, a binary system with a period of 80.8 days, and seen at an inclination just small enough not to produce eclipses, is an outstanding object for a long-term programme. A cooler and less massive companion filling its Roche lobe loses matter which reveals itself through the shell lines when the gas stream is seen projected on the B-type star (Peters 1982, IAU Symp. 98, p. 311). According to this model, noticeable photometric variations should only occur during the shell phases. In



Fig. 1: Differential b filter magnitudes HR 2142 – HR 2344 plotted versus phases of the 80.82-day period. Shell phases occur at phase 0.5.

fig. 1, D. Baade has plotted our observations of HR 2142 (phase 0.5 corresponds to the primary shell phase) and shows that there is no modulation of the light curve with phase of the orbital period. Unfortunately the short shell phases (spanning less than 8 days) were missed twice as they fell outside the observing times. A more fortunate coincidence between shell phase and observing time will teach us more about the photometric activity during that phase. Fig. 1 also shows that the brightness of the star was essentially constant for most of the time, but on two different levels. Only from future long-term monitoring of this star can we learn if this 0^m13 decrease in all passbands is related to certain phases of the orbital period or if other periodicities are present.

Another highlight is undoubtedly the discovery of an S Dortype outburst in the Of star R 127 (See Wolf & Stahl's article in this issue of the *Messenger*). A remarkable result is also the discovery of the binary nature of the luminous LMC supergiant R81. By combining older photometric data with data obtained by various observers in our project, F. Zickgraf (Landessternwarte Heidelberg) found a period of 29.18 days. Fig. 2 shows the average light curve. The residual scatter is larger than expected from the photometric accuracy, but this is due to intrinsic variability of the supergiant. The shape of the light curve indicates that R81 is probably an eclipsing contact binary. The star will be given highest priority during the September and December 1983 observing runs.

Besides the direct scientific results, the programme offers several attractive aspects. Young observers who have not established their own field of research may join one of the teams of our group, in that way they will acquire experience in



Fig. 2: Average V-light curve of R81 constructed with a period of 29.18 days.

different fields of variable star work. The project definitely stimulates international collaboration, especially for what concerns events of opportunity (e.g. simultaneous coverage with other ground-based or space observations).

There is also a close collaboration with Dr. J. Maza (Universidad de Chile) regarding information about events such as bright galactic novae.

The actual group consists of 22 participants. We do hope that more people from different countries will join the project.

Discovery of an S Dor Type Outburst of an Of Star at La Silla

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What are S Dor Variables?

Back in 1897, E.C. Pickering reported on the variable star S Dor in the Large Magellanic Cloud (LMC). A quarter of a century later, J.C. Duncan (1922) and M. Wolf (1923) independently discovered a few variable stars in M 33. Since the extragalactic nature of these galaxies was not yet established in those days (i.e. their distances were not known) these authors could not realize that they had discovered some of the most luminous variables of the Universe with absolute visual



Fig. 1: Photoelectric light curves in the Johnson V band of the prototype S Dor and of R71 of the LMC in the periods 1968 to 1983 and 1971 to 1983, respectively.