Extinction in H II regions can be estimated by comparison of the absolute Hα or Hβ fluxes with the radio continuum fluxes (of course, the optical and radio determinations must refer to the same points in the sky and must have comparable angular resolutions). Or we can measure the Balmer decrement – in particular the Hα/Hβ ratio – which provides the total extinction via the reddening law. If the extinction occurs well outside the emission region, and is uniform over the solid angle observed, these two methods are equivalent and give the same results for, say, A_V. In practice this does not always work. For example, Israel and Kennicutt (1980, *Astrophysical Letters* **21,** 1) show that A_v estimated from a comparison of the optical and radio fluxes of giant extragalactic H II regions is almost always greater than that derived from the Balmer decrement. These questions are discussed by Lequeux et al. (1981, *Astronomy and Astrophysics,* **103,** 305). Quite aside from any possible deviations from the standard reddening law, differences between the two determinations are expected if the external extinction is not uniform and/or if the dust is located within the H II region. Further effects arise because of scattering of the nebular light. Thus, comparison of these two determinations of A_v can give information on the characteristics and location of the dust.

Observations and first results. We observed about 50 of the optically brightest H II regions of the LMC with the ESO 50 cm telescope in December 1981. The circular diaphragm had a diameter of 4.9 arcmin, which allows comparison with the 6 cm continuum observations of McGee et al. (1972, *Australian Journal of Physics* **25,** 581) which were made with a 4 arcmin Gaussian beam. In addition, some regions were observed at several positions, with higher resolution. This was the case for N 159, which is formed of several small components and is situated near a region of active star formation.

Both atmospheric extinction and absolute instrumental calibration were determined primarily with the standard star χ Eri (Tüg, 1980, *Astron. Astrophys. Suppl.* **39,** 67). From each observation we have obtained the absolute Hα and Hβ fluxes and thence the Hα/Hβ ratio. Results obtained from repeated measurements, some with different filters and on different nights, indicate errors of a few per cent in the ratio.

Note that FPs are generally coated for a rather narrow range of wavelengths, and therefore cannot be used for *both* Hα and Hβ. Prof. E. Pelletier, of the Ecole Nationale Supérieure de Physique in Marseille, kindly supplied us with the special broadband dielectric coatings which were used for these observations.

Fig. 5 indicates the ratios measured in the LMC. Extinction in the Cloud is generally low. It is very low (or zero) for the regions located along the bar (N 23, N 103, N 105, N 113, N 119, and N 120). It is also low for all the large ring-shaped H II regions such as N 154, N 120, N 11, N 51 D, and N 206. The highest extinction (Hα/Hβ > 4, corresponding to E(B-V) > 0.3 mag), is measured in the 30 Doradus Nebula, and it remains high in the nearby H II regions N 157 B and MC 69. A relatively high extinction is also found in the direction of N 160 and especially of N 159 (Hα/Hβ ~ 3.9, corresponding to E(B-V) ~ 0.28 mag), H II regions situated at the edge of the LMC's largest H I molecular complex, an area of active star formation (as shown by the presence of OH and H_2O masers and of the only compact IR source yet observed in the LMC). The regions N 48, N 79, N 81, N 83, N 59, and N 164 also exhibit a relatively high extinction for LMC H II regions.

These ratios are generally consistent with those obtained for a few objects by Peimbert and Torres-Peimbert (1974, *Astrophysical Journal* **193,** 327) and Dufour (1975, *Astrophysical Journal* **195,** 315), with slit spectrographs. Comparison of the absolute fluxes with the radio measurements is underway. The results will be submitted to *Astronomy and Astrophysics.*

Concluding Remarks

Our spectrophotometer may soon become obsolete. A new generation of Fabry-Perot instruments, including the English TAURUS (see Atherton et al., 1982, *The Messenger* **28,** 9) as well as CIGALE, which we have developed at the Observatoire de Marseille, uses two-dimensional photon-counting detectors. The result is a wavelength scan for *each pixel.* So far, the emphasis with such instruments has been on kinematic work, but thanks to recent progress in detectors, there is no reason why they cannot be used for accurate two-dimensional photometry.

CN Orionis, Cooperative Observations for 24 Hours per Day Monitoring

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Introduction

When modern technologies open the possibility of astronomical measurements in wavelength regions from γ rays to the ultraviolet and from the infrared to the radio band, the visual range shrinks to a very small interval in the flux diagrams. However, the time of use of the necessarily complex and expensive instruments is very limited. Observing runs of an hour or so are of little use for the investigation of astronomical events like stellar outbursts which evolve with timescales of days. So even optical telescopes with apertures below 1 m still have a relevance for long-time observational programmes.

An interesting group of objects which is known to show variations in the time scale mentioned is the class of cataclysmic variables (CV). The general model for all members consists of a Roche lobe filling secondary (near the main sequence) which transfers matter via the Lagrangian point L_1 to the highly evolved primary, a white dwarf or neutron star. Due to its angular momentum the mass stream does not impact but rather surrounds the small primary, building a more or less circular accretion disk. A hot bright spot is produced where the initial stream collides with the already circulating material of the disk. By angular momentum exchange part of the disk material finally reaches the primary.

The increasing amount of information from all kind of observations has made clear that the class of CVs comprises many kinds of interesting objects like X-ray sources, oblique magnetic rotators with synchronized rotation or with rotation with critical periods of up to 10 s and systems emitting highly polarized radiation from strong magnetic fields of 10^7 G. Prominent properties of CVs are eruptions with a large range of amplitudes. The more violent events, nova eruptions (> 10 mag) are caused by thermonuclear runaways on the primary. This explanation is quite secure although the nova explosion of a system is so rare that until now it was observed only once for an individual object. The dwarf novae brighten up by a factor of 10 or 100 for a few days only, but every 10 to 1,000 days. In spite of the more detailed observations, there is no generally accepted explanation for their eruption.

Dwarf Nova Eruption and Theory

At present two models are under discussion, challenging observational and theoretical attempts in order to find the decisive result or argumentation. Certainly, the increased radiation of a dwarf nova eruption originates in the accretion disk. But no agreement has been achieved about the initializing mechanism. One hypothesis (Osaki, 1974) assumes that after an interval of quiescence during which the accretion disk accumulates the incoming material, an instability causes a sudden increase of the viscosity, yielding rapid outward transport of angular momentum and hence inflow of matter. Consequently, gravitational energy is released heating up the disk. The problem is that the physics of the viscosity and its variations are not well understood. The theoretical work of Meyer and Meyer-Hofmeister, 1981, is a step towards a better understanding. Currently there are still doubts whether this model can fully explain the observations.

The alternative hypothesis is based on theoretical work by Bath (1973) who found repeating instabilities in the secondary which cause an increase in the mass transfer rate. The disk is assumed to be stationary, i.e. the same amount of matter which enters into the disk leaves it through a transition layer onto the white dwarf. Since the disk luminosity is determined by the gravitational energy released from the throughput of material, a sufficiently increased mass transfer rate in a stationary disk would be seen as an outburst.

Observable Properties and Observing Programme

As mentioned before, the impact of the mass stream onto the disk's edge causes a bright spot, which is a relevant radiation source in many systems. Its manifestation in the lightcurve is a criterium for mass exchange and hence classification of the star as CV. Since the density in the stream and/or the outer disk fluctuates, corresponding variations in brightness are observed. In those cases where the orbital inclination is large ($i \gtrsim 50°$), the bright spot is obscured behind the disk for ½ of the orbital period, causing a hump-shaped lightcurve. Thus the hump intensity, flickering, phase and shape can be taken as indicators for the mass stream, its transfer rate, homogeneity, trajectory and cross section. All of these characteristics can be analysed in the case of CVs with $i > 75°$, since they show a hump and eclipses of primary, disk and bright spot. But until now only few such objects are known and they do not show outbursts very frequently. Non-eclipsing CVs with humps in their lightcurves are less appropriate, though still valuable for an investigation of the mass stream in the sense that some effect must be observed in the hump shape, intensity, or phase when the stream increases by an order of magnitude, as is assumed in Bath's model for the dwarf nova eruption.

Previous photometric observations of the hump during rise and maximum of an outburst did not indicate large variations of its amplitude. However, the results obtained during the bright phase are quite inaccurate since the relative hump amplitude decreases to a few per cent. If Bath's model applies, variations in the bright spot are expected before the disk brightens and at that time they should be easily detectable.

Dwarf nova eruptions are not exactly predictable, so that their observation generally is initiated by messages from the amateur astronomer associations. Thus the transition phase from quiescence to an eruption is scarcely covered by observations. Another complicating fact for the observations is that the increased mass transfer might last for a short time interval only. Such a mass pulse will endure at least for the hydrodynamical timescale of the secondary of the order of hours, equivalent to the orbital period. This guarantees that the flashing of the bright spot is principally observable and cannot be missed while being obscured by the disk.

The necessary observational programme is clear: Start a 24^h per day photometry of a dwarf nova in quiescence and continue until an eruption takes place (i.e. eventually for a whole eruption cycle). The selected object should at least show a hump in its lightcurve, the eruption cycle should be as short as possible and the object should be bright, since only small telescopes would be available for an observing run of approximately the outburst cycle. 24^h per day observations involve at least three observatories during summertime when the weather is good. More difficulties than usual arise in such programmes: The coordination of observing time at several observatories, the weather at different sites and the activity of the object.

The First Campaign

Joint observations for 16 nights could be organized at Cape Observatory, ESO and Hobart Observatory for December 1981. Dr. B. Warner kindly took care of the observations at Cape. Dr. B. Stolz from Sternwarte München travelled to Hobart Observatory and the author went to La Silla. The final selection of the object was facilitated by the help of the Royal Astronomical Society of New Zealand, which sent information about what was going on with the candidates befor our observing run. The favourite candidates were CN Ori and VW Hyi. CN Ori has a very short eruption cycle of 14 days, shows humps, but the orbital period was not exactly known at that time, its sky position was good, except that the full moon would come very close to it and it would be at the brightness limit during quiescence for the 50 cm ESO telescope. VW Hyi, the brightest southern dwarf nova, shows a hump and its sky position was optimal, far from the moon. But its outburst cycle is 30^d. The final choice depended entirely on their activity just before the start of the observations. Unfortunately, none of the eclipsing systems could be selected. A few days before the run, messages from F. Bateson, New Zealand, and Dr. B. Warner, South Africa, arrived, telling "VW Hyi in outburst!". Thus there was no chance to observe another eruption within the 16 days of our run. Unfortunately, CN Ori had also brightened, but there was still a possibility of another eruption. Hence CN Ori was selected, and this turned out to be right as can be seen from Fig. 1. Now the 50 cm ESO telescope had to be powered up by an image tube eyepiece, which had been taken along from Munich. This proved to be essential, since the minimum of CN Ori (fainter than 15.5 between the humps) happened to coincide with the date of full moon at a distance of around 20°. "Fortunately", the brightest nights before and during full moon have been the only cloudy ones and lost. During the night after full moon, with a seeing of 5–7" it was difficult but possible to centre the object. The important phase, 2 days before outburst until maximum light, was covered as shown in Fig. 1. It demonstrates clearly that there is no large variation in the hump amplitude, shape or phase just before the eruption. This rules

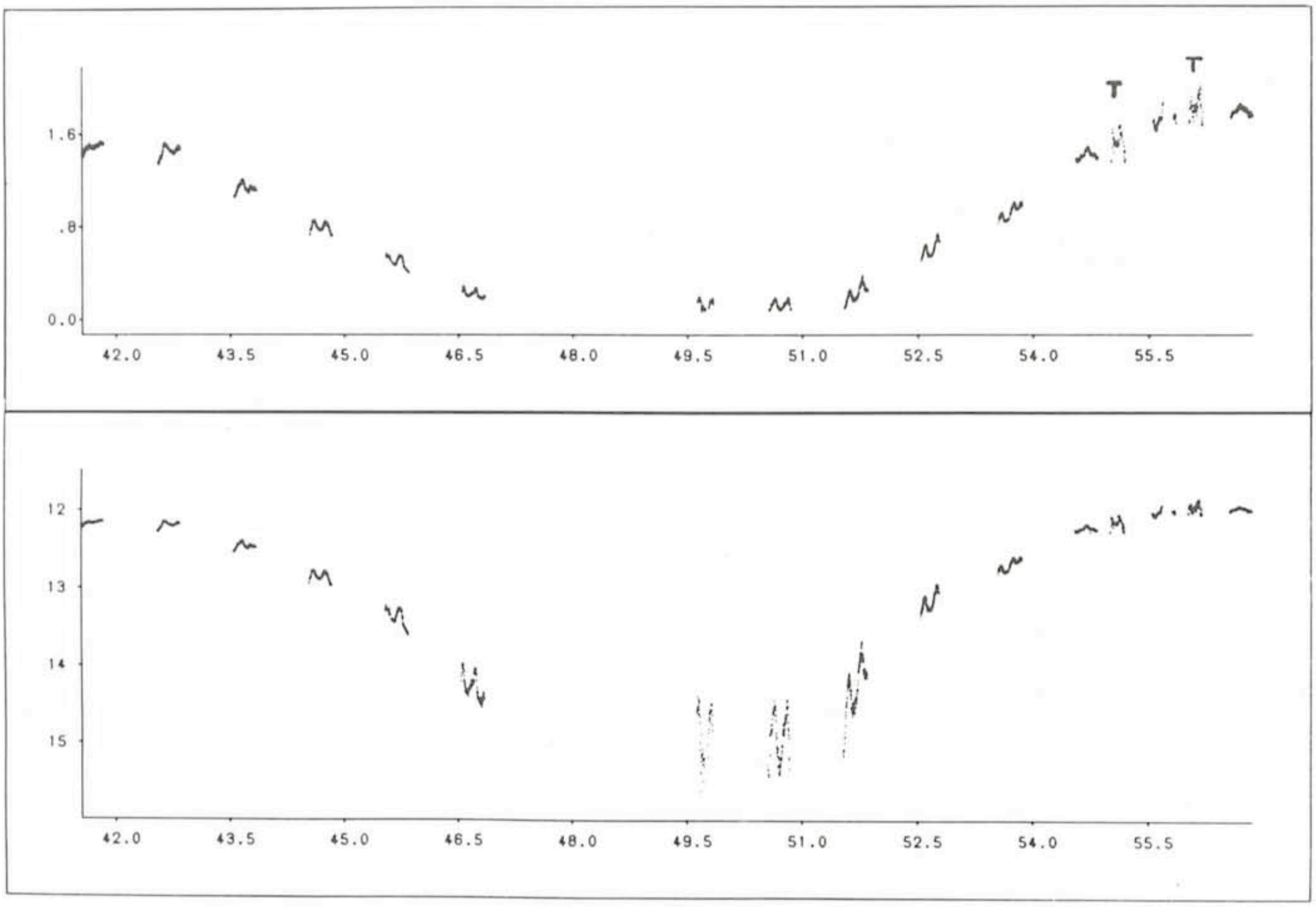

Fig. 1: *Lightcurves of CN Ori in white light (blue sensitive cathode S11) obtained during 1981, December 3 to 18 at La Silla and Hobart Observatory (denoted by T). Upper panel: Intensity ratio to a nearby comparison star. Lower panel: Magnitudes (λ_{eff} = 4000 Å). Time: HJD-2444900.*

out a relevant longer lasting increase in the mass transfer rate (Schoembs, 1982). A short mass burst could have been missed during the daily breaks. It is likely, however, that the eruption started with a symmetric brightening of the disk while the mass stream remained unchanged, i.e. the Osaki model can be applied. At the two other observatories, observations were almost completely frustrated by the weather conditions. Two nights of photometry were obtained at Hobart and only a few hours at Cape. The Hobart data (Fig. 1, runs marked by T) showed stronger variations than those of the ESO nights. Unfortunately, the intermediate La Silla observation, which also displays increased variations, is of low quality itself (break is due to passing clouds). On the other hand, a lightcurve obtained by Warner (1982) during another eruption in 1972 Feb. 17 shows a similar behaviour. So at that moment it was not possible to draw any other conclusion from the increased variability than that it is very important to observe this phase again. The increased light variations in the 3 consecutive runs near maximum around JD 2444955-56 may indicate irregularities in the mass transfer rate. But this must be interpreted in terms of feedback of the increased disk radiation to the secondary and not in the context of an initial instability as the reason for the eruption. Such feedback effects may also be important in the case of the so-called superoutbursts (SO). The cycle of SOs is larger and more regular than that of the normal short outbursts (NO), showing that an additional clock is effective. This clock could be the timescale of the secondary, which allows a reaction to the feedback, only after the corresponding interval of the order of 100 days (Vogt, 1983).

The fact that SOs were observed for the short-period systems only, may be understood in this context: The masses of the primaries do not depend strongly on the orbital period. Generally one may also assume that the disk luminosity in outbursts does not strongly depend on the period. Thus the

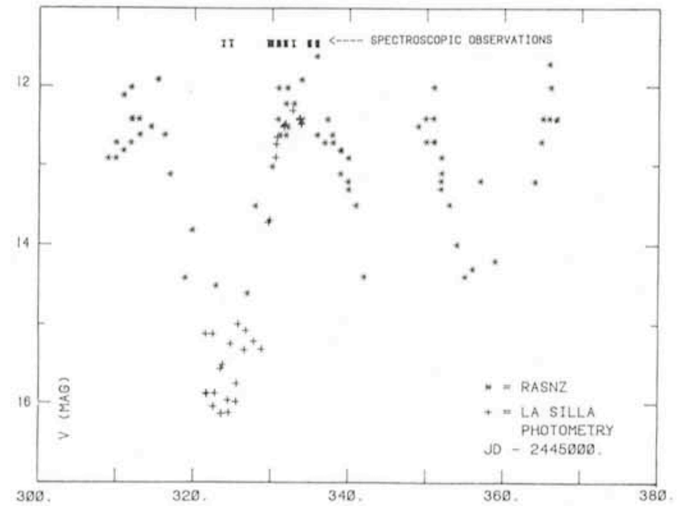

Fig. 2: *Visual magnitudes (*) of CN Ori as observed by the Royal Astronomical Society of New Zealand and magnitudes in white light (+) obtained at La Silla (S11 cathode) during 1982, November until 1983, February.*

secondaries in the smaller short-period systems are more affected by the outburst radiation. TU Men shows SOs although it has an unusual large orbital period but its outburst amplitude is also exceptionally large. Hence it is probable that both outburst models have their physical counterpart.

A periodogram analysis of the whole set of data for CN Ori revealed two similar photometric periods of $0\overset{d}{.}163$ and $0\overset{d}{.}159$. The longer one with approximately twice the amplitude of the shorter one. Double periods have been observed in the case of a few other CVs as well, e.g. V603 Aql.

The Second Campaign

The breaks in the photometric sequence, the detection of 2 photometric periods, and the increased variation at light maximum motivated another attempt for continuous observations in late 1982 from an increased number of sites including spectroscopy. The following observatories and observers participated in that programme:

Country	Observatory	Observation	Observer
Australia	Mount Stromlo	S	Barwig
	Siding Spring	P	Barwig
Brazil	São Paulo	P	Jablonski Steiner
Chile	La Silla	P/S	Seitter, Schoembs
India	Kavalur	P	Ravendran, Ashok
Israel	Mitzpe Ramon	P	la Dous, Schmid
Mexico	San Pedro Martir	P	Haefner
New Zealand	Auckland	P	Marino
South Africa	Cape	P	Warner
Spain	Calar Alto	P	Hartmann, Metz
Tasmania	Hobart	P	Waterworth

S = Spectroscopy: P = Photometry

Observations and Preliminary Results

This time CN Ori was at minimum and stayed so for a long time. 120 hours of almost uninterrupted photometry during quiescence were obtained. Later on, the weather caused several breaks. In total, observations from 28 days partly in UBVRI and/or white light and 75 spectra were collected. The photometric data have not all arrived in Munich, but reduction has been started. Final results cannot be given yet. Fig. 2 shows the visual brightness of CN Ori as obtained by the Royal Astronomical Society of New Zealand (*) and mean values obtained from observations in white light at La Silla (+). The large scatter is due to the unresolved hump in the lightcurve. Times of spectroscopic observations at La Silla are also indicated. The daily mean of the spectra taken at La Silla are shown in Fig. 3. They mainly could be obtained because of the kind cooperation of Prof. W. Seitter. A smooth continuum has been subtracted to demonstrate the variation of the lines. The first two spectra obtained during quiescence exhibit H_α and H_β in emission. Starting with the very beginning of the eruption, the spectra display broad absorption lines of Hydrogen and He I which prevail throughout the whole bright stage. At maximum brightness the lines are strongest. The 6th spectrum is a single one, badly calibrated due to clouds; the line intensity is

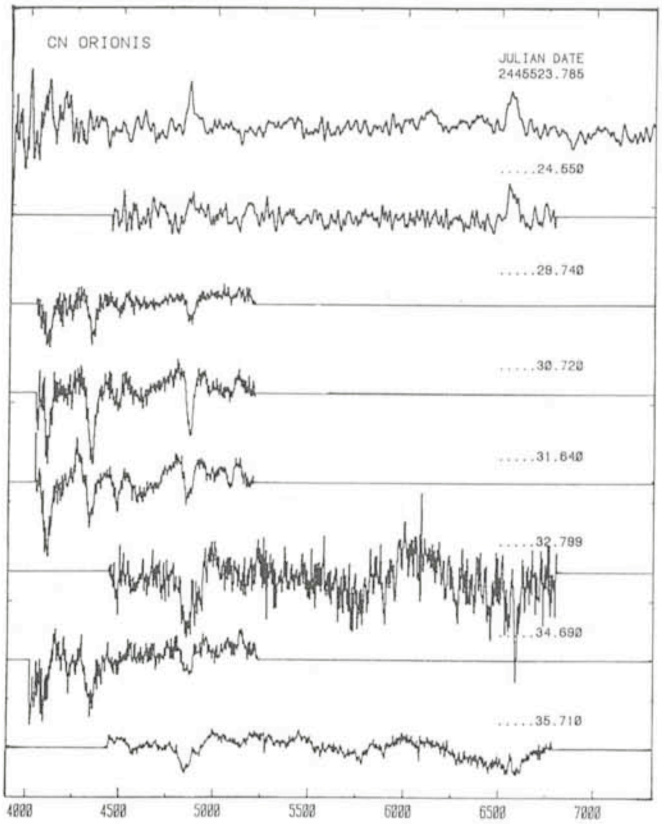

Fig. 3: *Nightly mean spectra of CN Ori obtained at La Silla during 1982, December 20 until 1983, January 1.*

exaggerated. Some spectra show emission wings of extreme width, occasionally symmetric or only on the red or blue side. In the later spectra narrow emission peaks within the broad absorption profiles of H_β and more clearly H_α can be seen. The absorption lines become weaker in the last two nights. There are indications of filling in by broad emissions. During the last night, variable cirri and moon light caused incomplete sky elimination. Hopefully the 37 spectra from La Silla together with additional 38 obtained at Mount Stromlo will allow to determine the orbital period from radial velocities and to distinguish which one of the two photometric periods is the orbital one.

Short-period Oscillations of CN Ori

The photometric data with high time resolution of the first campaign (roughly 100,000 integrations of 2 sec) were analysed for very short periodic light oscillations, which are frequently observed in cataclysmic variables. If strictly periodic, they are explained by the rotation of an oblique magnetic white dwarf. Dwarf novae often show transient oscillations during the declining part of the outburst. The periods vary inversely to the brightness. The relative amplitude of these oscillations is rather small ($< 1\,\%$) with a period around 30 s. Fig. 4 shows the power spectra of all nights from 1981. Two significant peaks are marked with the corresponding periods. They confirm the inverse correlation with the system brightness. Their relative amplitudes are of the order 10^{-3}. Interpretations of the mechanism are still speculative. Patterson (1981) showed that the observed quasi-periodic oscillations of this kind just exceed the period of critical rotation of the primary. Any relation of the oscillation period with the mass and radius of the primary would be quite important, since it could provide an additional method to determine the still relatively uncertain masses of the primaries in CVs.

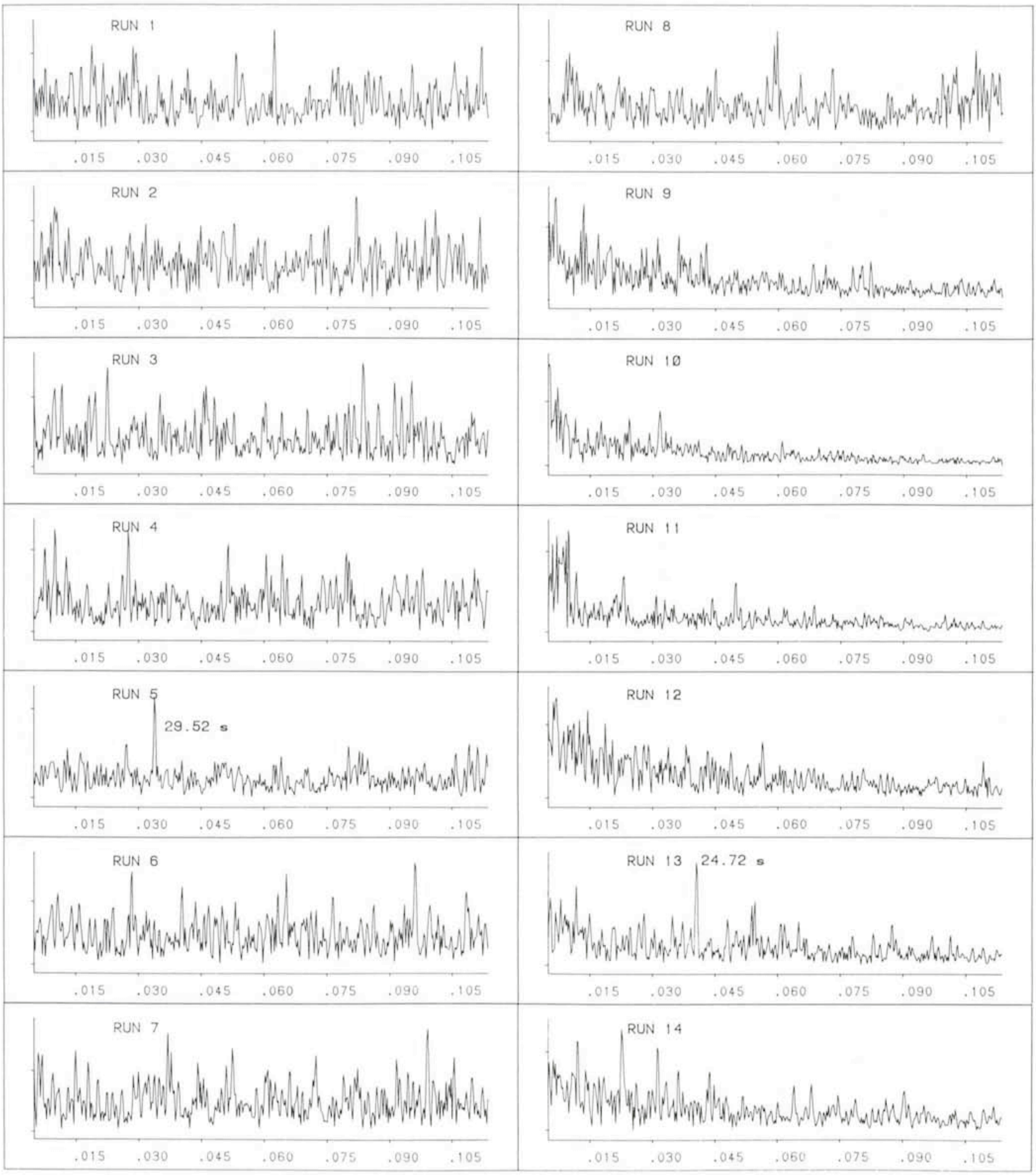

Fig. 4: *Power spectra of the photometric runs obtained at La Silla in 1981, December 3 to 18. Two significant periodic oscillations are indicated in runs 5 and 13. All other peaks remain below the 3σ significance limit.*
Ordinate: Relative Power. Abscissae: Frequency in Hz.

Acknowledgement

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