predicts a value around 40. Even when saturation effects in the Balmer lines and collisional processes are taken into account, the expected line ratio is not changed very much. In order to explain this discrepancy, Ferland and Netzer (1979: *Astrophysical Journal*, **228**, 274) have included the effects of internal dust in their calculations and obtain a value Lyα/Hβ = 13 for internal E(B–V) = 0.15. This model is marginally consistent with our results. If Akn 120 were to have no internal dust, however, there would still be a discrepancy of at least a factor of 3 between observation and theory.

Fortunately, the important line ratios Lyα/C IV 1550/He II 1640/C III] 1909 are not affected strongly by internal dust as long as E(B-V) < 0.15. We have compared our observed values with dust-free model calculations by Davidson and Netzer (1979: *Reviews of Modern Physics*, **51**, 715) and obtain a reasonable fit for a certain value of the adjustable parameter U_1. U_1 is equal to the ratio of the density of incident ionizing photons to the electron density in the broad line filaments. Once a value for U_1 has been fixed, the temperature and ionization stratification within the filament is given. Due to the presence of the C III] 1909 line, the electron density should be of the order of 10^9 cm^{-3}. The temperature in the region where helium is singly ionized is about 17,000 K. It is possible to estimate the distance of the filaments from the central source of ionizing radiation, if the flux of ionizing photons, the electron density and the value for U_1 are known. Extrapolating the observed UV continuum to wavelengths shortward of the Lyman limit, we estimate the typical distance of the filaments to the central source to be 1 pc. A more realistic model of the broad line region should include tens of thousands of filaments each with a different value for U_1, depending on its distance from the central source. These filaments would cover about 10% of the sky as seen from the central continuum source.

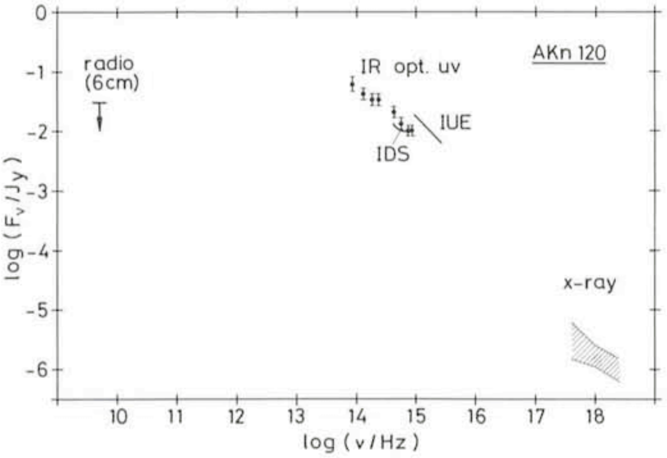


Fig. 4: *The overall spectrum of Akn 120, combining observations in various frequency ranges by several authors during 1968 to 1980. At 5 GHz (6 cm), only an upper limit of the flux is known.*

Very little is known about the nature of the central source which provides the energy radiated away directly in the continuum or indirectly in the emission lines. From the variability of the continuum, its size must be smaller than 30 light days, much smaller than the distance to the broad line producing filaments. Fig. 4 shows the distribution of the continuum over a large range of the electromagnetic spectrum. The continuum decreases from the infrared to the soft X-ray region with an overall spectral index of $\alpha = 1$ ($F_\nu \propto \nu^{-\alpha}$). At 6 GHz the object was weaker than 30 mJy, indicating a cut-off somewhere in the mm or cm wavelength range.

There is a jump of a factor of 2 in the flux between the optical and ultraviolet. Because the optical and UV measurements were made only 20 days apart, it is unlikely that such a jump can be explained by the source's variability alone. Low-redshift QSOs often have a bump in their continuum in the spectral range where this jump occurs in Akn 120. Simultaneous optical and UV measurements of Akn 120 are necessary in order to clarify the situation.

NEW FACILITIES AND IMPROVEMENT OF EXISTING INSTRUMENTATION

Fast Photometry – New Facilities at La Silla

H. Pedersen, ESO

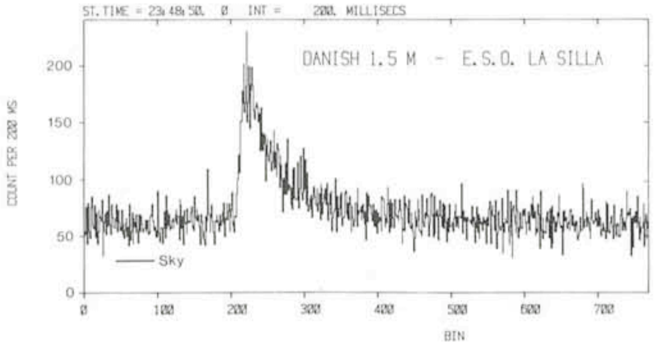
The standard photometric equipment at La Silla has 1 second of time as the shortest integration time. This is fully sufficient for most observing programmes. There are, however, several kinds of phenomena which have timescales of about a second or shorter. Among the fastest phenomena, one could mention the optical outbursts of the X-ray bursters (see *The Messenger* No. **18**, 34) or occultations of stars by objects in the solar system.

The astronomer who intends to do such observations will normally need to know the absolute time of each single integration, at least to an accuracy corresponding to the duration of the integration. Various computer programmes and pieces of hardware have hitherto been accommodated to the needs of the La Silla observers, but so far, all timing information had to rely on calibrations using radio signals, e.g. the WWV time-signals at 15 kHz.

The availability of an atomic-beam clock on La Silla (*The Messenger* No. **16**, 11) prompted us to design a new set-up for doing "fast photometry". As soon as the basic principles of operations had been defined, Messrs. D. Hofstadt and F. Gutierrez started programming. Within 10 days they had completed a programme of about 2000 lines of assembler code—without an error. Immediately thereafter, the programme, with its associated hardware, was taken into use both at the 3.6 m and the Danish 1.5 m telescopes.

The fastest data-taking rate is 1 kHz, but any integer multiple of 1 ms can be used as integration time. The photomultipliers interchangingly feed two sets of counters, one set being read while the other is counting. Thereby, the loss of time between two successive integrations can be kept very short—of the order of nanoseconds. Each single integration—from up to four photomultipliers—is written on magnetic tape for later analysis. An on-line pen recorder shows the signal strength in two of the channels. The time resolution of the pen recorder can be selected as any integer multiple of the integration time.

The programme is controlled from a Hewlett Packard terminal. From there, the observer selects integration time and



An example of a typical application of the fast-photometry software. The figure shows an optical outburst of the X-ray burster MXB 1636–53 recorded on July 8, 1980. The burst rises in about 2 seconds to nearly 5 times its pre-burst average. The observation was made in white light at the Danish 1.5 m telescope at La Silla.

starts/stops the data acquisition. Other commands allow changes of the time base and scale parameters for the pen recorder. The observer can also request to be informed about the average of the following N integrations, N being an observer-defined integer.

After the end of the observations, the magnetic tape or selected parts of it can be replayed on a graphic terminal or plotted on an x-y plotter. This can eventually be done at a lower time resolution than used for the observations. The off-line programme, together with similar editing, copying and listing programmes, have been written by Dr. C. Motch. We intend also to write a conversion programme that will transform the data to the FITS format.

So far, the programme has been used with the Behr photometer, the IR photometer and the new general-purpose photometer, all at the 3.6 m telescope and at the Danish 1.5 m with the Roden photometer, the Strömgren photometer and a Danish double-channel photometer. At the two remaining photometric telescopes, the ESO 50 cm and 1 m, the new fast-photometry software cannot be used because of different hardware configurations. When used with the IR and general-purpose photometers at the 3.6 m telescope, the diaphragm and filter wheels have to be set in advance. Later on, however, we intend to merge the fast-photometry programme with the normal photometry programmes, thereby giving the observer full command over the instrument.

Pointing of the 3.6 m Telescope

André B. Muller, ESO

The pointing of a telescope on a certain celestial object is achieved when the object is acquired in the field of view of the telescope and on the centre of a cross-wire system or any marking that indicates the centre of this field. Star acquisition with the 3.6 m telescope is computer-controlled. However, the behaviour of the telescope, mainly concerning flexures in the telescope structure, misalignments in the telescope axes and optics, must be known in detail. To find the different contributions to the total pointing error, a pointing programme was developed at the Anglo-Australian Observatory by P. Wallace for the pointing of the Anglo-Australian telescope, and this programme was made available to the author, thanks to Donald Morton, Director of the AAO, and P. Wallace.

The author performed the first pointing tests at the prime focus of the 3.6 m telescope, and the data were reduced at the AAO by P. Wallace, who developed a pointing model for this telescope. Basically, this pointing model is still in use. For some errors, which were discovered in the long run, corrections to the existing ones were added.

Pointing at the Cassegrain focus showed large erratic errors, and it took quite some time to locate the cause. Pointing tests showed a weakness in the support of the Cassegrain mirror, caused by the collimation device. Transducer measurements performed by J. van den Brenk, P. Halleguen and J. van der Ven of the TRS (Technical Research Support) group of ESO-La Silla clearly demonstrated this weakness. It was effectively cured by J. van der Ven, and new tests showed a considerable improvement in pointing.

The pointing programme was implemented in the telescope computer by D. Hofstadt, head of the TRS, and is used for pointing in the prime focus with the Gascoigne corrector and in the Cassegrain focus with any auxiliary equipment.

The programme for the remote control of the triplet adapter in the prime focus does not yet allow the implementation of the pointing programme. However, for the time being, an HP 41 calculator can take care of the pointing with this equipment.

Results

Table 1 shows the pointing results of last August 23/24 and 24/25 at the prime focus equipped with the triplet adapter; r being the distance between the centre of the cross wire and the calculated pointing position:

$$r = \sqrt{(\Delta h \cos \delta)^2 + (\Delta\delta)^2}$$

where Δh is the error in hour angle and $\Delta\delta$ the error in declination for the acquired object.

The first line contains the rms errors in r, $\Delta h \cos \delta$ and $\Delta\delta$. The remaining part of the table shows how many stars in quantity and percentage were acquired within 5, 10, 15 and 20 arcseconds. The table shows that the pointing in declination is better than in right ascension.

Table 2 gives the results of the pointing test at the Cassegrain focus last August 27/28. It needs no further explanation. Here again the pointing in declination is better than in right ascension.

Table 1

Prime focus Aug 23/24 + 24/25. 83 objects.

n (83)	r = 0″ ± 7.″1	Δh cos δ = 0″ ± 6.″1	Δδ = 0″ ± 3.″6
n ≤ 5″	38 = 45.8 %	51 = 61.4 %	71 = 85.5 %
n ≤ 10″	74 = 89.2 %	78 = 94.0 %	83 = 100 %
n ≤ 15″	82 = 98.8 %	82 = 98.8 %	−6″ ≤ Δδ ≤ + 8″
n ≤ 20″	83 = 100 %	83 = 100 %	

Table 2

Cassegrain focus Aug 27/28. 53 objects.

n (53)	r = 0″ ± 6.″5	h cos δ = 0″ ± 6.″4	Δδ = 0″ ± 3.″8
n ≤ 5″	30 = 56.6 %	41 = 77.4 %	46 = 86.8 %
n ≤ 10″	46 = 86.8 %	48 = 90.6 %	51 = 96.2 %
n ≤ 15″	53 = 100 %	53 = 100 %	53 = 100 %