PHOTOMETRIC AND SPECTROSCOPIC OBSERVATIONS OF THE CATACLYSMIC VARIABLE AC CANCRI

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ABSTRACT

The eclipsing variable AC Cancri, recently identified as a cataclysmic variable by Shugarov (1981) and Okazaki, Kitamura and Yamasaki (1982), was further studied in detail on the bases of UBV-colours, multi-channel photoelectric light curves and image-tube spectrograms which were newly obtained at Tokyo Astronomical Observatory. The result of analysis of these materials for the nature of the cataclysmic variable is presented.

AC Cnc was discovered to be a variable star by Kurochkin (1960). Subsequently, Kurochkin and Shugarov (1980) found that this variable is an eclipsing binary with the orbital period of $P = 0^{d}.30047768$. From UBV photoelectric light curves Shugarov (1981) suggested that AC Cnc is an ex-nova or a nova-like object. Okazaki, Kitamura and Yamasaki (1982) have identified AC Cnc as a cataclysmic variable from spectroscopic and photometric observations made in April 1981.

In order to study the nature of this cataclysmic variable in detail, we further made photometric and spectroscopic observations at Okayama and Dodaira Stations of Tokyo Astronomical Observatory as follows:

- UBV photoelectric photometry with the 0.9-m reflectors at Okayama and Dodaira during October 1981 to January 1982,
- multi-channel photometry with the 1.9-m reflector at Okayama in January 1982,
- spectroscopic observations using a Cassegrain image-tube spectrograph attached to the 1.9-m reflector at Okayama in April 1982.

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From UBV photoelectric observations the average magnitude and colour indices of AC Cnc outside eclipses during October 1981 to January 1982 were obtained as

$$V = 14.2$$
$$B - V = +0.4$$
$$U - B = -0.5.$$

Compared with this period, the star was brighter in April 1981 by $0^m.6$, $0^m.5$ and $0^m.4$ in U, B and V, respectively. Kurochkin and Shugarov (1980) already reported occasional increases in brightness of AC Cnc, and we have confirmed the erratic fluctuations in brightness outside eclipses. The colour indices for AC Cnc yield a position in the region where the majority of the cataclysmic variables fall in the (U - B, B - V) diagram.

A multi-channel photoelectric photometry of AC Cnc was made in the following six channels:

Channel 1	λλ3330 - 3700,	Channel 2	λλ3820 - 4190,
3	λλ4300 - 4670,	4	λλ4780 - 5150,
5	λλ5265 - 6005,	6	a narrow pass band at Hβ.

As an example, the observed light curve in Channel 3 is shown in Fig. 1. A hot spot may be present but not so strong since a hump seen just before the primary minimum is rather weak.

In the multi-channel light curves outside eclipses flickering can be seen with a time scale of 10 - 30 min, rather long compared with flickering occurred in many other cataclysmic variables, but such flickering with a long time scale as seen in AC Cnc is also reported in the case of Lanning 10 (Horne, Lanning and Gomer, 1982).

We have obtained altogether eight Cassegrain image-tube spectrograms of AC Cnc, seven in blue and one in red, with a dispersion of 110 A mm^{-1}. Broad emission lines of Balmer series Hα - Hδ were found superimposed on a blue continuum spectrum. He II λ4686, and possible C III - N III λ4650, appear in emission in the spectrograms which were taken on April 30, 1981 (Fig. 2), when AC Cnc was bright. The profile of Hβ was found to vary with the orbital phase. This may indicate a non-uniform distribution of the temperature on the accretion disk (a hot spot).

In order to analyse the light curve, we combined photon counts of the multi-channel photoelectric observations in Channels 1, 2 and 3 to construct a wide-band light curve. Then, this light curve was analysed by a synthetic method (e.g., Young and Schneider, 1980). In the analysis we employed a binary model which consists of a circular accretion disk lying on the orbital plane and a spherical red dwarf star whose radius is equivalent to its critical Roche radius. The brightness distribution of the disk is assumed to be given by a power law of $r^{-\beta}$. The orbit is also assumed to be circular.

The solution of the light curve analysis could not be uniquely determined, but it is given as a function of the mass ratio q = M(red dwarf) /M(white dwarf). For example, in the case of q = 1 other system parameters are given by

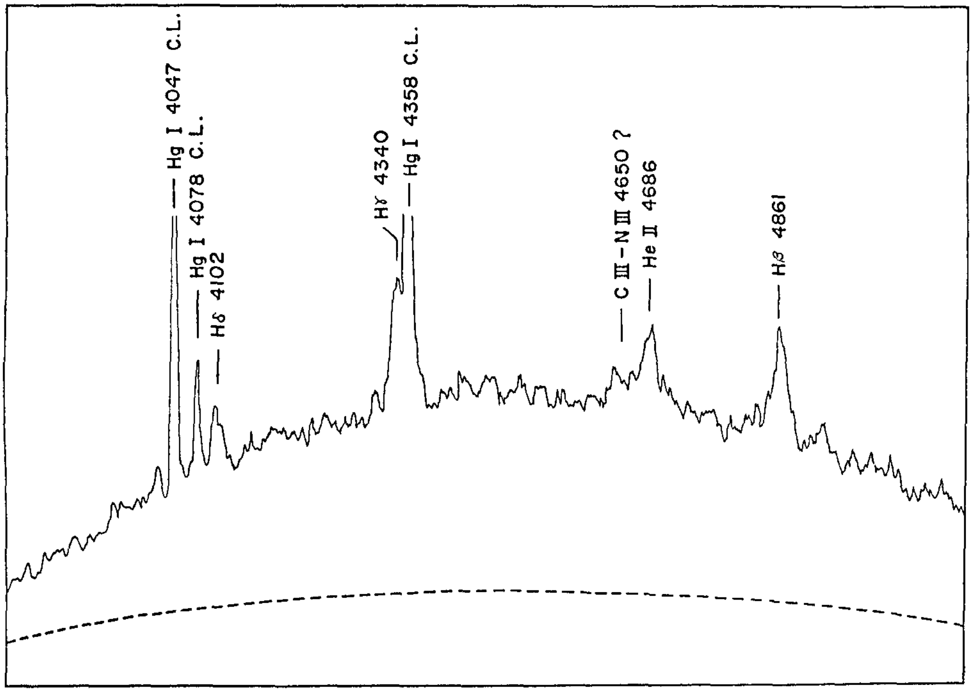

Figure 1. An intensity tracing of the spectrogram of AC Cnc taken on April 30, 1981. The broken line represents the sky background.

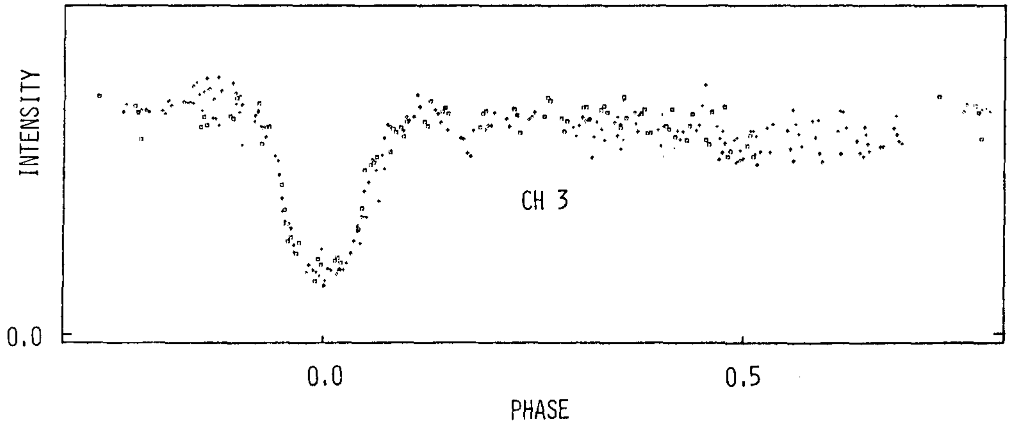

Figure 2. Light curve of AC Cnc in Channel 3 (λλ4300 - 4670).

$i = 75°$
$r(\text{disk}) = 0.43$
$r(\text{red dwarf}) = 0.38$ (q = 1 assumed)
$\beta = 1.25$.

Anyhow it is evident that the size of the disk is fairly large compared with that of a non-viscous disk, and this should be in favour of a viscous disk model. As far as the light curve and the geometry of the system are concerned, it is found that nova-like variables AC Cnc and Lanning 10 (Horne et al., 1982) are very much similar to each other.

REFERENCES

Horne, K., Lanning, H. H. and Gomer, R. H.: 1982, Astrophys. J. 252, 681.
Kurochkin, N. E.: 1960, Astron. Tsirk. No. 212.
Kurochkin, N. E. and Shugarov, S. Yu.: 1980, Astron. Tsirk. No. 1114.
Okazaki, A., Kitamura, M. and Yamasaki, A.: 1982, Publ. Astron. Soc. Pacific, 94, 162.
Shugarov, S. Yu.: 1981, Astron. Zh. 58, 583.
Young, P. and Schneider, D. P.: 1980, Astrophys. J. 238, 955.

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