OPTICAL AND UV OBSERVATIONS OF THE INTERMEDIATE POLAR 3A0729+103. MODULATION WITH THE ORBITAL PERIOD.

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ABSTRACT

3A0729+103 (= BG CMi) is an intermediate polar discovered through its X-ray emission (McHardy et al. 1981, 1984). The orbital period is 3.235 hours and the rotation period is 15.2 minutes. For ephemeris and references on the source we refer to McHardy et al. (1984). We report here on optical (4025 to 5090 A) and ultraviolet (1200 to 3200 A) spectroscopy obtained, respectively, on Dec 1, 1984 and April 21, 1985. Our data show clear modulation of spectral features with the orbital period.

1. THE OPTICAL DATA

A succession of 140 spectra, covering 1.4 orbital cycles, was obtained at the INT (La Palma) with the RGO spectrograph and the IPCS. The FWHM resolution was 1.5 A and the exposure time was typically of 60 seconds. The average of individual spectra obtained within 0.2 bins of orbital phase is shown in Fig. 1. Hβ , Hγ , Hδ , HeII λ4686 and CIII-NIII $\lambda\lambda$4640,4650 appear in emission, strongly modulated with orbital phase. The e.w. of Hβ and Hγ are shown in Fig. 2 a and b vs. orbital phase; some evidence of modulation with the rotational period is also present (Fig 2 c and d). The complex profile of Hβ is shown in detail in Fig. 3 at selected orbital phases. The wavelength of the peak varies from λ4867 around ϕ = 0 to λ4856 around ϕ = 0.5. This can be attributed either to a modulation with phase of the radial velocity (S wave; see Penning 1985) or to the superposition of two displaced ($\pm$ 300 km/s) components with phase modulated intensity. HeI λ4471 shows a drastic change with phase, turning from emission at ϕ = 0.0 to absorption at ϕ = 0.6 (Fig. 4).

Paper presented at the IAU Colloquium No. 93 on 'Cataclysmic Variables. Recent Multi-Frequency Observations and Theoretical Developments', held at Dr. Remeis-Sternwarte Bamberg, F.R.G., 16–19 June, 1986.

Astrophysics and Space Science **131** (1987) 631–635.

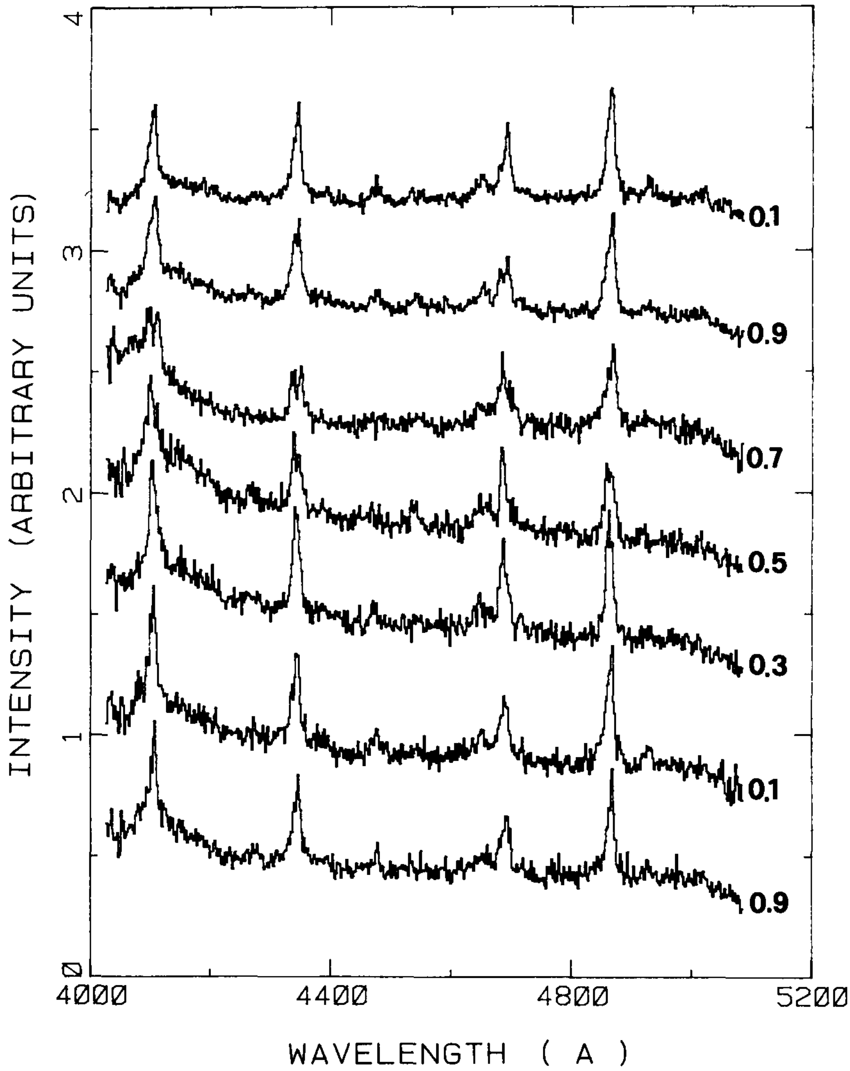

Fig. 1 - A sequence of optical spectra of 3A0729+103 averaged over orbital phase bins of 0.2 units. Spectra are labelled with the relevant orbital phase.

2. THE ULTRAVIOLET DATA

The ultraviolet observations cover two consecutive orbital cycles with exposure time suitable for studying orbital modulation. The mean ultraviolet brightness is comparable to that observed in 1984 November-December (Falomo et al. 1985). The 1350-1500 A continuum clearly exhibits orbital modulation (see Table I), which is substantially stonger than in the optical continuum. Also C IV, whose e.w. is larger when the continuum is more intense, suffers strong phase modulation (Fig. 5); detailed comparison with modulation of the optical lines is prevented by the coarse sampling available in the UV.

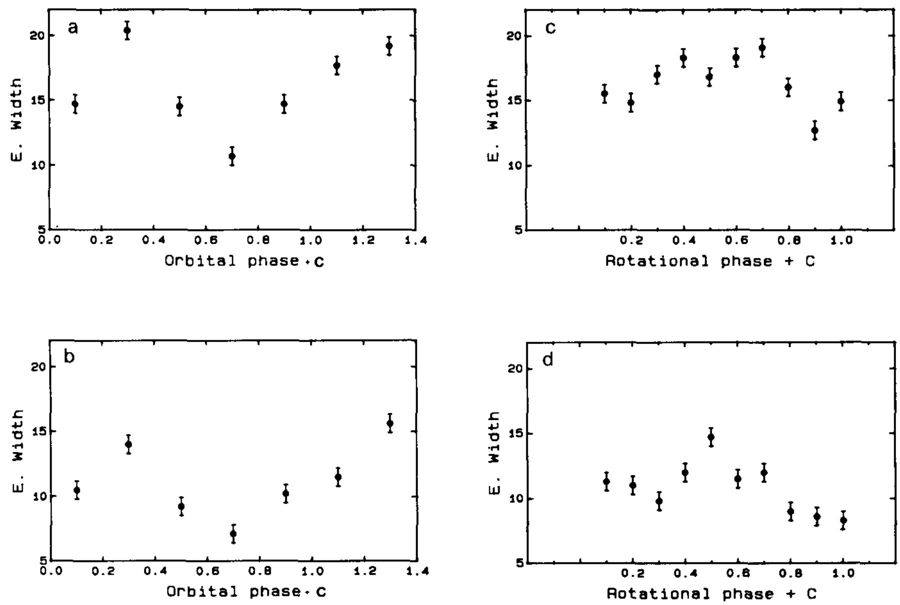

Fig. 2 - Equivalent widths of Hβ and Hγ modulated with orbital phase (frames a and b) and with rotational phase (frames c and d).

3. DISCUSSION

The present observations show complex variations of the optical and ultraviolet line spectrum of 3A0729+103. In particular, the modulation of lines with both the orbital and the rotational period is demostrated. Two points are worth mentioning: i) the modulation with the orbital period is suggestive of a single maximum curve, ii) the amplitude of the orbital modulation is larger than that of the rotational one. The latter point strongly suggests that the bulk of the line emission does not occur at the top of the accretion column, as proposed for AM Herculis type objects, even if the magnetic field strength in 3A0729+103

https://doi.org/10.1017/S0252921100105433 Published online by Cambridge University Press

is possibly close to that of polars (Penning et al. 1986). If the main region responsible for the line emission is the boundary between the disc and the accretion column, as in the model proposed by Penning (1985), our results indicate that the disc is asymmetric so that its visibility varies with the orbital phase.

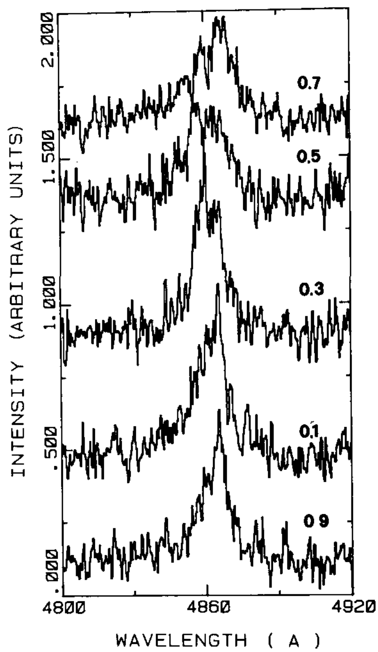

Fig. 3 - H β profile modulation with orbital phase.

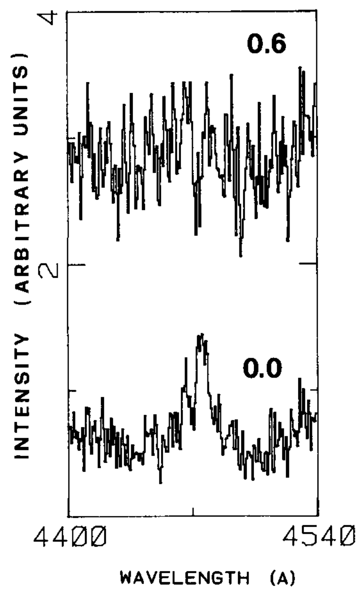

Fig. 4 - HeI λ 4471 turns from emission at orbital phase 0.0 to absorption at phase 0.6.

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https://doi.org/10.1017/S0252921100105433 Published online by Cambridge University Press

TABLE I – UV OBSERVATIONS OF 3A0729+103

IMAGE NUMBER	EXP TIME (sec)	ORBITAL PHASE	F(1300–1500 A) (10^{-14} erg/cm^2 s A)	C IV e.w. (A)
SWP 25755	2400	0.83	2.4 ± 0.1	26 ± 3
SWP 25756	3600	0.28	1.8 ± 0.1	18 ± 3
SWP 25757	3600	0.79	2.7 ± 0.1	24 ± 3
SWP 25758	3600	0.28	1.6 ± 0.1	15 ± 4
SWP 25759	1800	0.69	2.2 ± 0.1	24 ± 3
			F(2500–3100 A)	
LWP 5785	1500	0.02	1.2 ± 0.1	
LWP 5786	1800	0.54	1.6 ± 0.1	
LWP 5787	1800	0.04	1.4 ± 0.1	
LWP 5788	1800	0.53	1.5 ± 0.1	

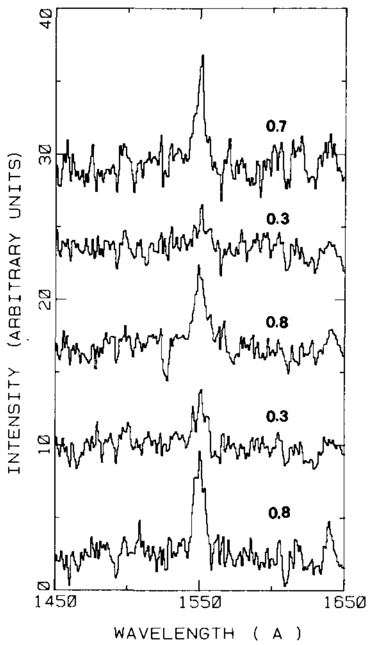

Fig. 5 – C IV λ1550 profile modulation with orbital phase.

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