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NON-STATIONARY GAS ACCRETION ON UX ORI TYPE STARS

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The results of spectroscopic monitoring of the photometrically most active UX Ori type stars in the vicinity of a resonance doublet of Na I lines are presented. It is shown, that variable red-shifted absorption components are frequently observed in these lines. Their radial velocities reach 300 km s^{-1} in some episodes. Appearance and disappearance of these components occurred sometimes within 1 day. In some episodes saturated absorption components were observed, indicating the fact that the gas clouds, in which the components are formed, are opaque in the lines D_1 and D_2 of the doublet and screen only a small part of a stellar disc. A hypothesis of rough comet-like activity in the vicinity of these stars seems rather likely due to these features and the fact that neutral sodium is observed directly near young hot stars.

KEY WORDS Herbig Ae/Be stars, circumstellar lines, accretion, proto-comets

1 INTRODUCTION

Stars with non-periodic Algol-type brightness minima belong to a small subclass of young stars, the prototype of which is the star UX Ori (Bibo and Thé, 1990). In the course of multiyear photopolarimetric monitoring of the UX Ori type stars (UXORs) it has been shown (Grinin *et al.*, 1991; Grinin, 1992), that their photometric activity is caused by variable circumstellar (CS) extinction in the edge-on oriented protoplanetary discs. There is growing observational evidence that the violent comet-like activity takes place in the immediate vicinity of these stars (see Grinin, 1994; Grinin *et al.*, 1994; Grady *et al.*, 1995, and references therein).

Here we present additional results of spectroscopic observations of several UXORs indicating the infall of CS matter on to these stars, similar to those found by the French group (Lagrange *et al.*, 1987) in the spectrum of β Pictories.

2 RESULTS

The low-resolution ($R = 3000$) spectral observations of some UX Ori type stars around the Na I D and Hα lines were carried out during the observational seasons

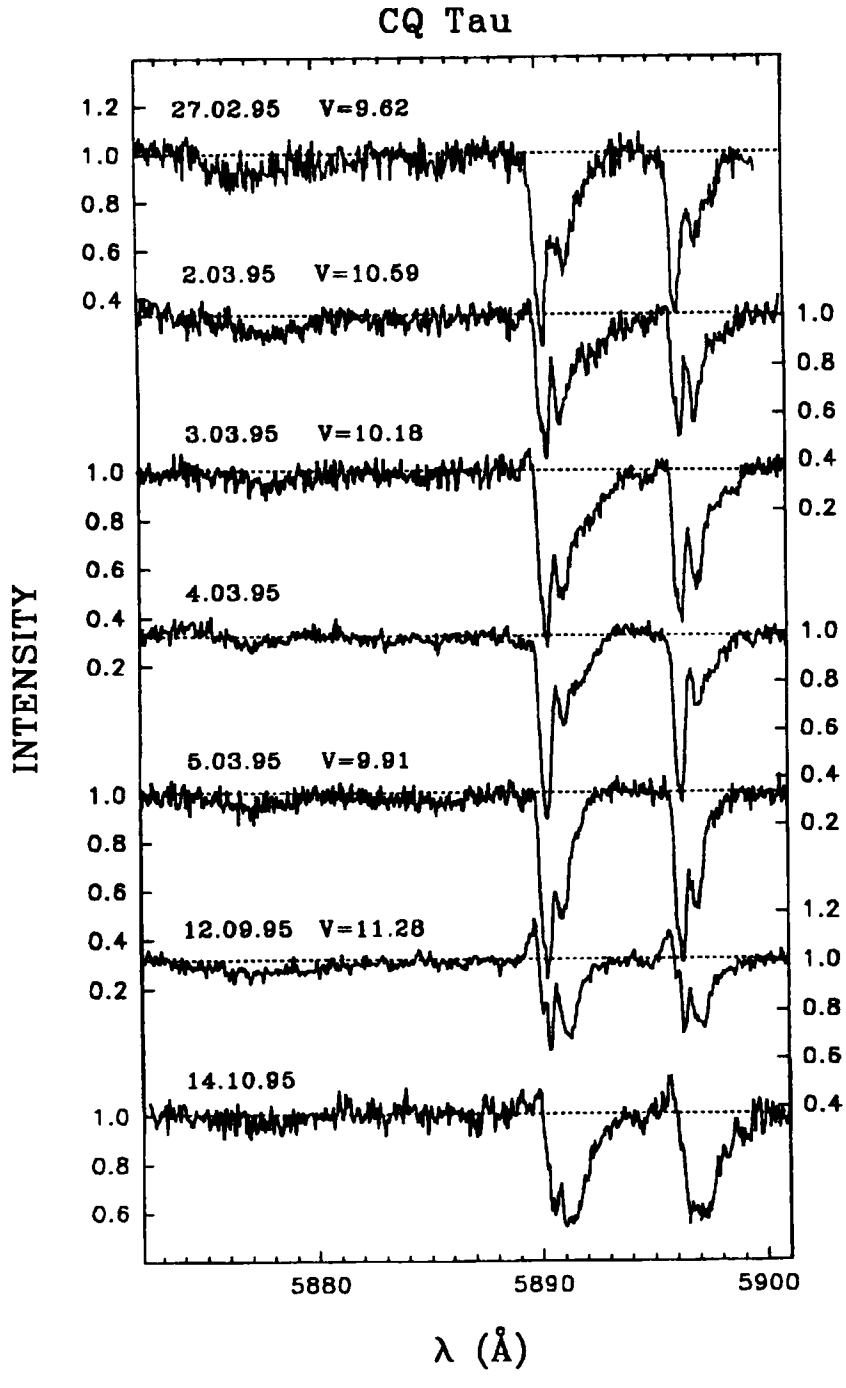

Figure 1a The CQ Tau spectra in the region of the Na I lines. The redshifted absorption CS components are clearly seen.

of 1992–1993 with the 2.6-m telescope of the CAO. In 1993 we continued the observations with a higher resolution ($R = 18000$). In all cases the spectral observations were supported by synchronous *UBVRI* photometry with the 1.25-m telescope.

The most important results of low spectral resolution observations were summarized in the paper by Kozlova *et al.* (1995). It was shown that:

(1) In many cases the Hα line has asymmetric two-component profiles typical for disc accretion.

(2) A strong and variable He I 5876Å absorption line is observed that is non-typical for A-stars. This line indicates the existence of hot gas near the star and can be interpreted as resulting from shock front formation in the accretion flows. A similar interpretation of the He I 5876Å line was suggested earlier by Guenther and Hessman (1993) for T Tauri star BM And.

The results of high-resolution spectroscopic observations of four UXORs (RR Tau, WW Vul, BF Ori and CQ Tau) are presented in the papers by Grinin *et al.* (1996) and Kozlova *et al.* (1996). The most important accretion signatures were observed in the sodium D Na I lines (see Figure 1a). They are the variable redshifted absorption components similar to those found earlier in the spectrum of UX Ori itself (Grinin *et al.*, 1994). Their maximal radial velocities reach 200–300 km s^{-1} indicating gas infall on to the star. The existence of neutral sodium in the immediate vicinity of the relatively hot young stars (spectral type A) is a non-trivial observational fact. Quantitative analysis shows (Sorelli *et al.*, 1996) that the accreting gas with a normal chemical composition can produce such absorption components only in models with very high mass accretion rates ($\dot{M}_{\rm acc} \geq 3 \times 10^{-7} M_\odot$ yr^{-1}). Such a high $\dot{M}_{\rm acc}$ is incompatible with the absence of optical veiling in the spectra of HAEBE stars (Böhm and Catala, 1993) and with estimations by Hartmann *et al.* (1993) of the optical thickness of the accretion discs.

3 SUMMARY

We suggested (Grinin *et al.*, 1996) that the accretional phenomenon that we observe in UXORs is a more complex process in which the accretion matter is a mixture of CS gas of normal chemical composition (see Figure 1b) and the evaporated star-grazing planetesimal bodies (Figure 1a). If this is the case the UX Ori type stars can be considered as precursors of the well-known star β Pictoris.

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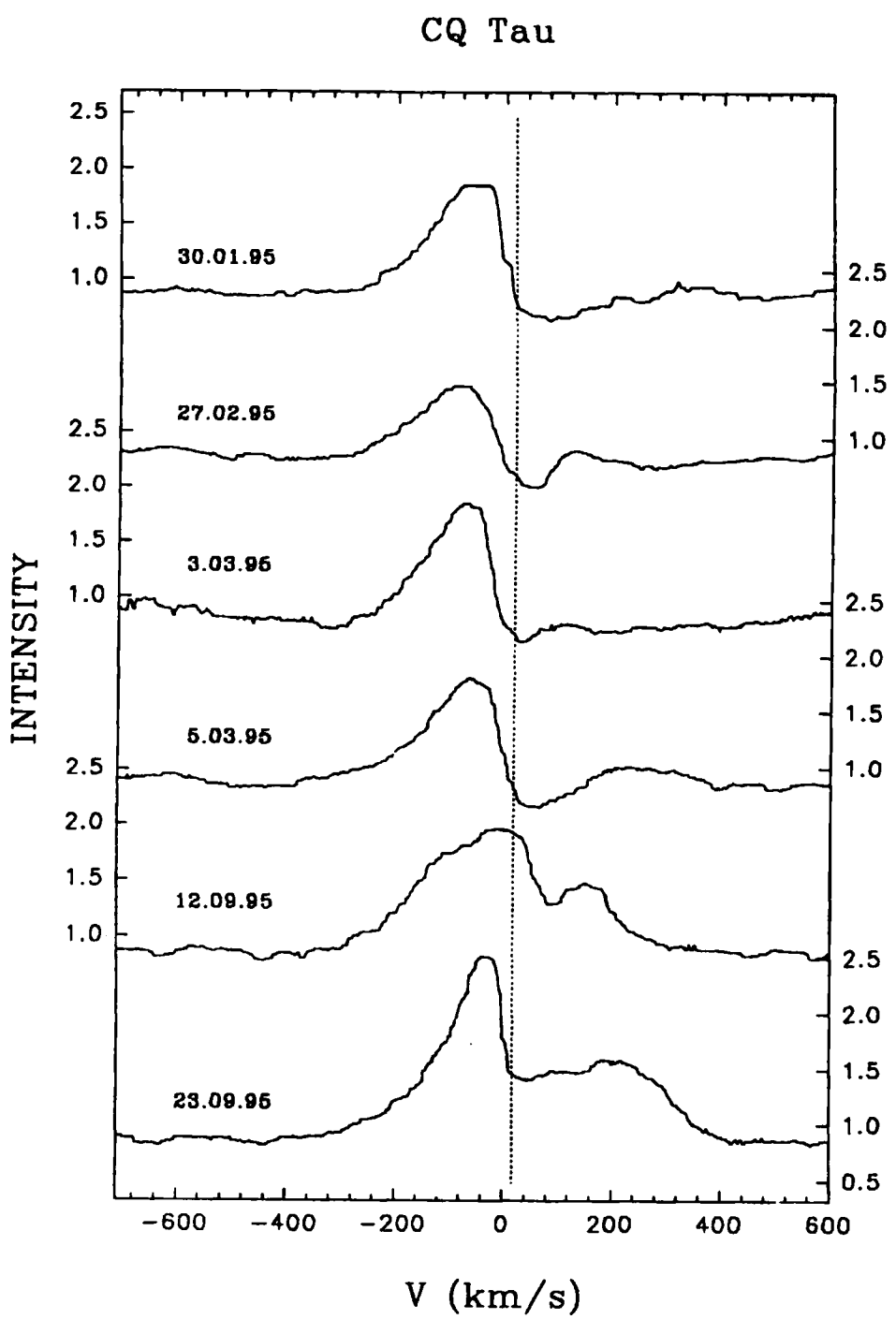

Figure 1b The high-resolution Hα line in the spectrum of CQ Tau.

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