RECENT PROGRESS ON THE POLAR QS TEL: THE HST RESULTS

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Abstract. We report on the Hubble Space Telescope (HST) observation of the polar, QS Tel, made during 1994 June. Orbital modulation is present in both the continuum and lines. A narrow dip is observed in the continuum folded light curve. The spectrum of the occulted source during this dip is broadly consistent in shape with the Rayleigh-Jeans tail of the EUV source.

1. Introduction

QS Tel (RE 1938−461), $P_{\rm orb} = 2.33$ h, was one of the brightest sources discovered in the EUV ROSAT WFC sky survey [1]. It has been seen to undergo a number of changes in its accretion geometry, having been seen accreting onto one pole in ROSAT observations [1][3] and onto two poles in an EUVE observation [3]. A deep, narrow dip has been found during one of the EUV/soft X-ray maxima, almost certainly caused by occultation of the accretion region by the gas stream from the secondary.

2. Observation and results

QS Tel was observed by the HST in 1994 June. Data were taken with the Faint Object Spectrograph (FOS) operated in rapid mode ($\Delta t = 20$ s). The G160L grating was employed to cover the 1154…2508 Å range at a resolution of 6.8 Å.

The mean spectrum shows a continuum rising slightly towards blue wavelengths, with strong emission lines of C IV, N V, Si IV and He II superposed. The continuum luminosity (1154…2508 Å) is $5.9 \pm 0.4\, 10^{31}$ erg s^{-1} (for a distance of 170 pc [4]), consistent with that observed by IUE in 1993 August [2].

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The orbital UV continuum light curve is simply modulated by a broad minimum at phase 0.7...0.8 with a depth of $\sim$ 18%. A 24% dip is observed covering phases 1.00...1.06, i.e., at the same phase as the dip observed in the ROSAT and EUVE data [3]. Modulation is present in the line fluxes, with a bright interval between phases $\sim$ 0.1...0.6. The line flux variation (peak to peak) is $\sim$ 45%. If a dip is present in the line flux, it is much broader and shallower than the continuum dip, spanning $\phi \sim 0.9 \ldots 1.2$.

The two brightest emission lines, C IV and He II, exhibit clear radial velocity motion, and can be characterised by a broad (velocity amplitude $\sim 400\,\mathrm{km\,s^{-1}}$) and a core (velocity amplitude $\sim 300\,\mathrm{km\,s^{-1}}$) component. We are unable to discern any difference in the velocity curves of the UV line components and their optical counterparts [3][4].

The radial velocity measurements of the two strongest emission lines find maximum red-shift (and thus inferior conjunction, assuming formation in the accretion flow close to the white dwarf) at phase 0.1 (both components) – this is also the phase of minimum line flux. Maximum line flux occurs at ϕ_{orb}=0.3...0.5, around the phase of first quadrature. This may reflect preferential photoionization of the stream on one side.

3. Discussion and conclusions

We do not know whether QS Tel was accreting onto one or two poles during this observation. However an IUE observation that took place only two weeks before the EUVE observation, which found QS Tel to be in a two pole accretion mode, had a similar luminosity to that of our data. If this implies a two pole accretion mode in our observation, the lack of a double peaked light curve argues against the polar regions contributing significantly to the flux.

The HST data shows a dip at phase 1.00...1.06. Subtracting the dip from the post-dip spectra reveals a strong far UV turn-up in the occulted source, which is consistent with the Rayleigh-Jeans tail of the EUVE black-body spectrum. The strength of the UV turn-up is only $\sim$ 20% of that expected on the basis of the EUVE observation; however QS Tel is known to vary by factors of $\lesssim 100$ in the EUV band [3]. The UV dip is probably caused by stream occultation of the white dwarf and polar accretion region.

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