1. HST Observations of the Fe II curtain in Cataclysmic Variables

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1.1. The Fe II curtain in cataclysmic variables

Following the discovery of strong Fe II absorption features in the white dwarf spectrum of OY Car by Horne et al. (1994), we present HST Faint Object Spectrograph G160L observations of three additional eclipsing dwarf novae, Z Cha, WZ Sge and V2051 Oph taken near eclipse and during quiescence, to determine if the phenomenon seen in OY Car is a typical characteristic of quiescent accretion disks. We also present follow-up observations of OY Car around its orbit to ascertain whether the phenomenon is visible only near the eclipse or throughout the binary orbit, and to determine the parameters and other characteristics of the gas as a function of binary phase.

1.2. Light curve decomposition, white dwarf spectra and the Fe II

We employed the same technique as in Horne et al. (1994) to separate the white dwarf, bright spot and disk spectra in all our targets. The white light curve was used to define the shapes of the three component light curves and the corresponding spectra were derived by fitting the light curve observed at each wavelength using a linear combination of the three component light curves.

The white dwarf models were calculated in the same way as in Horne et al. (1994). A small grid of plane-parallel, hydrostatic model atmospheres (10,000 K < $T_{\text{eff}}$ < 25,000 K, log $g$ = 8) were calculated using the program TLUSTY (Hubeny, 1988). We have assumed the solar composition. The program SYNSPEC (Hubeny 1994) was used to calculate the synthetic spectra. The intervening absorption curtain was modelled as a homogeneous slab of LTE gas which is parameterized by the temperature $T$, electron density $n_e$, velocity
dispersion $\Delta V$, and hydrogen atom column density $N_H$. Table 1 summarizes the curtain parameters for the preliminary fits to the white dwarf spectrum in Z Cha, WZ Sge and V2051 Oph and the best fit for OY Car in Horne et al. (1994). Although our results are preliminary, the values of the column density and the velocity dispersion are comparable to that in OY Car except in V2051 Oph where the velocity dispersion is much higher.

Our spectra of OY Car showed that the absorption regions located at $\lambda \lambda 1600$-$1800 \ \text{Å}$ and $\lambda \lambda 2200$-$2500 \ \text{Å}$, which are the typical signatures of the Fe II curtain, are present throughout the whole binary orbit reaching maximum absorption near binary phase 0.5 and is weakest just before white dwarf eclipse.

Table 1. Results of the preliminary fits to the white dwarf spectrum of Z Cha, WZ Sge and V2051 Oph, with the reduced $\chi^2$.

<table>
<thead>
<tr>
<th>Object</th>
<th>$T_W/10^3$ (K)</th>
<th>$T_{	ext{cur}}$ (K)</th>
<th>$\log (n_e \cdot \text{cm}^3)$</th>
<th>$\Delta V$ (km$^2$)</th>
<th>$\log (N_H \cdot \text{cm}^2)$</th>
<th>$\log (\Delta R_{\text{FW}})$</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z Cha</td>
<td>20</td>
<td>7034</td>
<td>12.72</td>
<td>25</td>
<td>16.09</td>
<td>-0.70</td>
<td>4.37</td>
</tr>
<tr>
<td>WZ Sge</td>
<td>15</td>
<td>9278</td>
<td>7.55</td>
<td>44</td>
<td>21.96</td>
<td>-0.35</td>
<td>0.3</td>
</tr>
<tr>
<td>V2051 Oph</td>
<td>15</td>
<td>4751</td>
<td>9.97</td>
<td>101</td>
<td>22.10</td>
<td>-0.26</td>
<td>2.3</td>
</tr>
<tr>
<td>OY Car</td>
<td>16.5</td>
<td>9930</td>
<td>12.94</td>
<td>58</td>
<td>22.10</td>
<td>-0.07</td>
<td>4.11</td>
</tr>
</tbody>
</table>

1.3. Conclusions

We have found that the white dwarf spectrum in all three objects is veiled by a large number of blended Fe II features (Fe II curtain) to varying strengths which we attribute to absorbing disk material along the line of sight to the white dwarf, possibly located in the upper atmosphere (chromosphere) of the disk. The weakest signature is found in WZ Sge: the one with the highest angle of inclination among our targets. We have carried out preliminary fits to the white dwarf spectrum and derived the temperature, density, column density and velocity dispersion of the absorbing gas (Table 1). These show that the high velocity dispersion and high column density detected in OY Car are also seen in Z Cha, WZ Sge and V2051 Oph. Furthermore, full orbital coverage of the ultraviolet spectra of OY Car show that the Fe II curtain features are present throughout the orbit and are not limited to the regions near eclipse. This supports the suggestion that the absorbing gas originates from the upper atmosphere of the disk, and may not be necessarily linked to the bright spot or induced by the impact of the gas stream.

References

Hubeny, I. 1988, Comp. Phys. Comm., 52, 103