FUSE observations of HD 5980: The Wind Structure of the Eruptor

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HD 5980 is a unique system containing one massive star (star A) that is apparently entering the luminous blue variable phase, and an eclipsing companion (star B) that may have already evolved beyond this phase to
become a Wolf-Rayet star. In this paper we present the results from FUSE observations obtained in 1999, 2000, and 2002 and one far-UV observation obtained by ORFEUS/BEFS in 1993 shortly before the first eruption of HD 5980. The eight phase-resolved spectra obtained by FUSE in 2002 are analyzed in the context of a wind-eclipse model. This analysis shows that the wind of the eruptor obeyed a very fast velocity law in 2002, which is consistent with the line-driving mechanism. Large amplitude line-profile variations on the orbital period are shown to be due to the eclipse of star B by the wind of star A, although the eclipse due to gas flowing in the direction of star B is absent. This can only be explained if the wind of star A is not spherically symmetric, or if the eclipsed line radiation is ``filled-in'' by emission originating from somewhere else in the system, e.g., in the wind-wind collision region. Except for a slightly lower wind speed, the ORFEUS/BEFS spectrum is very similar to the spectrum obtained by FUSE at the same orbital phase: there is no indication of the impending eruption. However, the trend for decreasing wind velocity suggests the occurrence of the ``bi-stability'' mechanism, which in turn implies that the restructuring of the circumbinary environment caused by the transition from ``fast, rarefied wind'' to ``slow, dense wind'' was observed as the eruptive event. The underlying mechanism responsible for the long-term decrease in wind velocity that precipitated this change remains an open issue.

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