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Hα DETECTION OF COLLIDING WINDS IN O-TYPE BINARIES

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RESUMEN

Presentamos resultados preliminares de un relevamiento de interacciones de los vientos de estrellas del tipo O en binarias de doble espectro. Hemos iniciado una serie de investigaciones de las variaciones de la emision de Hα segun la fase orbital en nueve sistemas boreales. El exceso de emisión en Hα se forma por recombinación en regiones de densidad relativamente alta, y puede ser usado para modelar la distribución de masa en el sistema. Utilizando espectros dinámicos, describimos la evolución orbital de las variaciones de Hα en dos sistemas.

ABSTRACT

We present the preliminary results from a survey of the wind interactions in O-type double-lined spectroscopic binaries. We have begun a series of investigations on the orbital phase variations in Hα for nine northern systems. Excess Hα emission is formed by recombination in regions of relatively higher density, and can be used to model the mass distribution of the system. Enhanced density may be caused by winds colliding between the stars and creating a bow shock. Using dynamical spectra, we describe the orbital evolution of the Hα variations for two of our targets exhibiting such emission.

Key words: **BINARIES: CLOSE — STARS: EMISSION LINES, Be — STARS: INDIVIDUAL (HD 35921, HD 36486)**

1. INTRODUCTION

The evolutionary paths of massive close binary stars depend in large measure on the relative importance of mass loss and mass transfer, and although mass loss in single massive stars is relatively well understood, the situation for binary stars is much more complex. If both binary components have significant winds, the winds will collide and form a bow shock between the stars.

We have begun a series of investigations on the orbital phase variations in Hα and the UV wind lines of O-type binaries to better understand the geometry of the wind-wind interaction. While the UV wind lines sample the large scale wind structure, the Hα emission is formed by recombination in regions of relatively high density, and thus it helps probe conditions in the base of the wind and in other regions of enhanced density, such as the bow shock. We present here the preliminary results from our survey of the Hα and HeI λ6678 Å lines.

2. OBSERVATIONS AND RESULTS

Spectra were secured at Kitt Peak National Observatory between the 17th and 22nd of September 1994, using the Coude Feed with grating A, 2nd order, camera 5, and the T2KB CCD detector. With this instrumental combination we obtained a resolution of 0.30 Å with a S/N ratio of approximately 300. Exposure times ranged from a few minutes to 2 hours, with average exposures of 30 minutes. Our goal was to sample the Hα and He I λ6678 Å profiles over a complete orbital cycle. Our targets included 9 systems with average orbital periods of approximately 4 days.

Interestingly, a visual examination of the main sequence systems showed no obvious Hα or He I emission, other than some stationary narrow nebular emission, and some possible weak broad emission. These systems will be discussed in detail in future presentations of the data.

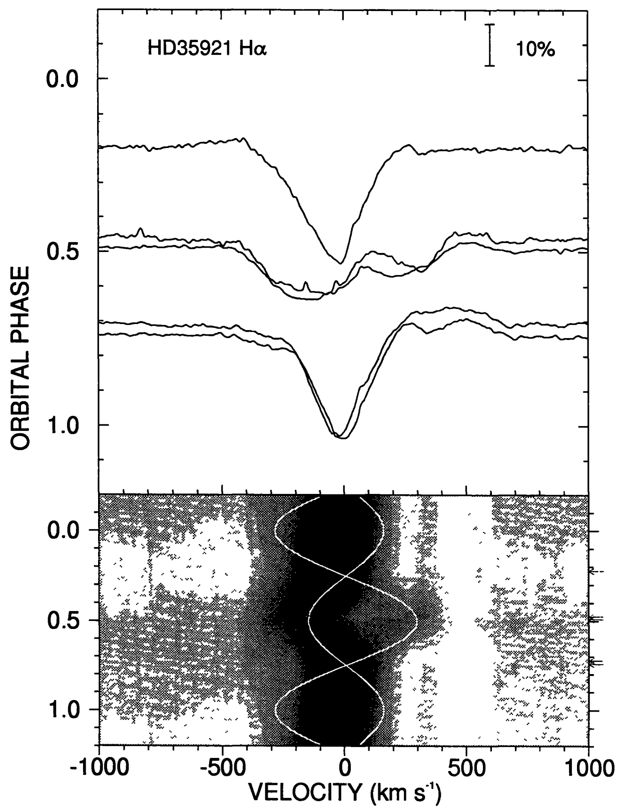

Fig. 1. Hα line profile variations of HD 35921. The spectra are plotted according to the orbital phase, with phase 0.0 defined as the point of maximum positive velocity of the primary. Phase 0.0 and 0.5 indicate quadrature points, while phases 0.25 and 0.75 are conjunctions. In the grey-scales, the orbits of the primary and secondary are plotted over the observations.

Of the observed systems, three which contain evolved members, namely HD 36486, HD 35921, and HD 167771, show unusual orbital phase variations in their line profiles. For each of these systems we were able to obtain between four and six observations. Figures 1 and 2 show the observed Hα line profile variations for the former two binary systems.

The results shown in the greyscales for the two binary systems, namely HD 35921 and HD 36486, are briefly described in the following:

2.1. HD 35921

The Hα spectrum of HD 35921 plotted at phase 0.53 (Fig. 1) shows substantial asymmetry, indicating emission in the red wing. A rough estimate of the velocity corresponding to this emission is 70 km s^{-1}, which is 20 km s^{-1} above the systemic velocity. This feature may also be visible to a lesser extent in the He I line. We suggest that this emission originates in a gas flow from the primary towards the secondary. This flow may also be indicated in the Hα profile at phase 0.85, which shows excess absorption in the blue wing. It is possible that this absorption is caused by light from the secondary passing through the stream.

Another interesting result from the observations of HD 35921 is a possible detection of the secondary component; a shallow, broad line is visible in both the Hα and He I spectra, especially at phase 0.53, where this feature is clearly seen to the red of the primary.

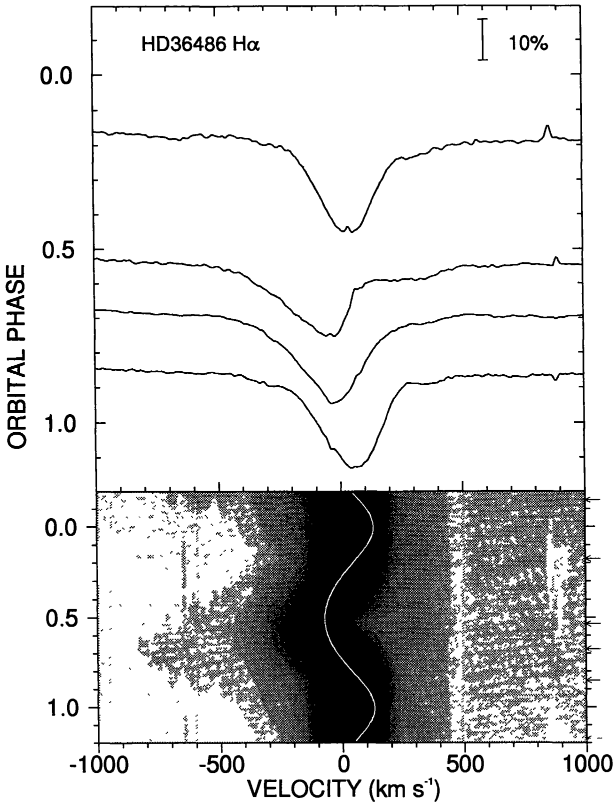

Fig. 2. As in Figure 1, but for HD 36486.

2.2. HD 36486

In the spectrum of HD 36486 there appears to be broad Hα emission at phases 0.25 and 0.75, where the stars would be in conjunction. This feature also seems to be moving, as it is observed to the red of Hα at phase 0.25, and to the blue at 0.75. This velocity change suggests a flow from the primary to the secondary also in this binary system. There may exist extended absorption in the red wing of the two spectra at phases 0.72 and 0.74.