OBSERVATIONS OF VELOCITY FIELDS IN WN AND Of STARS

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Systematic wavelength shifts of series of spectral line centers observed in many early type stars,generally interpreted as due to large scale motions,can give us information about the velocity gradients in stellar atmospheres.However,it should be borne in mind that the velocity gradients inferred from the observed displacements of spectral lines may not correspond to a unique alternative (e.g.see Karp 1978).Also,and especially when we are dealing with stars which have emission lines in their spectra,the structure of the velocity field depends on the assumed temperature structure of the atmosphere,i.e.in which atmospheric region do the lines originate.

In this paper observations of mean wavelength displacements of absorption and emission line centers are presented for six stars,namely, HD 86161 (WN8),HD 92740 (WN7), HD 93129A (O3If),HD 93131 (WN6),HD 93162 (WN6) and HD 163758 (O6.5If).The spectral classifications quoted in parenthesis are from Walborn (1973,1974),and the spectra of the first five stars are illustrated in Walborn (1974).The observational data for HD 86161 and HD 163758 are based on 38 Å/mm Cassegrain spectra obtained and measured with a Grant engine at the Cerro Tololo Inter-American Observatory,Chile.The observational data for the other four stars are given in Conti,Niemelä and Walborn (1978),where the structure of their envelopes related to the radial velocities is discussed.

Earlier results of the velocity gradients of the hydrogen Balmer absorption lines in some of the stars studied here suggested that strong velocity fields exist at the atmospheric level where the absorptions originate (Niemelä 1975;Conti 1977).In Figures 1 to 4 the mean wavelength shifts of absorption and emission line centers are represented as a function of the excitation potential of the upper energy level of the corresponding line. These figures show that in all stars studied

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here "velocity progressions" exist throughout the atmospheric regions where both absorption and emission lines arise.

The kind of "velocity progressions",i.e.a correlation with increasingly negative radial velocity with decreasing excitation potential of the upper energy level,shown in Figures 1 to 4 are generally interpreted as an outwards accelerated motion in a stellar atmosphere with outwards decreasing temperature.Although this same type of correlation seems to apply for the emission lines (Figure 4),however,the redshifts may not be due to a Doppler effect (e.g.Auer and Van Blerkom 1972).We note also,that the presence of a violet-shifted absorption edge in an emission line does not always produce a redshift.For example in Fig.4 the lines of SiIV and NIII show P Cygni type profiles,but the emissions are not redshifted.

The Figures 1 to 4 also suggest,and especially see Figure 1,a smooth transition in the velocity gradients with the spectral type,in the sense that for increasing ionization and decreasing strength of the emission lines,the wavelength shifts seem smaller.Thus the relationship between the Of and WN type spectra of these stars may be correlated to the atmospheric velocity fields.An extrapolation to all other stars showing Of and WN type spectra,however,is not obvious.

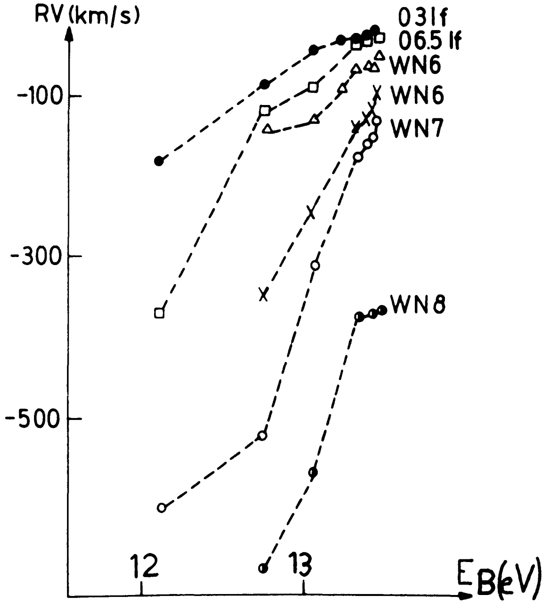

Figure 1. The mean displacements of the absorption line centers (in km/s) of the hydrogen Balmer series as a function of the excitation potential of the upper energy level of the corresponding line:HD 93129 (filled circles);HD 163758 (rectangles);HD 93131 (crosses);HD 93162 (triangles);HD 92740 (open circles) and HD 86161 (half-filled circles).

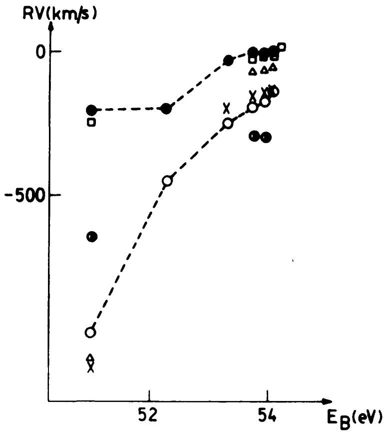

Figure 2. As in Fig.1 for the HeII absorption lines.

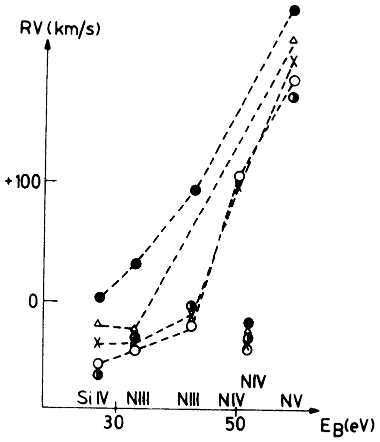

Figure 4. As in Fig.1 for the narrow emission lines of SiIV, NIII,NIV and NV.Note the distinct value of the NIV 4057 singlet on the lower right of the Figure.

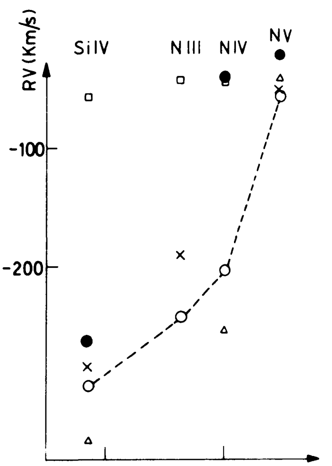

Figure 3. As in Fig.1 for the P Cygni absorptions of SiIV, NIII,NIV and NV.

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DISCUSSION FOLLOWING NIEMELA

Massey: I couldn't quite see from the graphs how did the velocities of the Si IV, N III emission lines compare with the uppermost Balmer absorption lines H 10, say. Were they very different?

Niemela: The upper Balmer lines have more negative velocity than the Si IV, N III emissions, which are not red shifted. The difference between the velocities of the upper Balmer absorptions and the narrow emissions depends on the spectral type.