THE HYDROGEN ABUNDANCES IN WN STARS

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Hydrogen abundances in WN stars have been derived by Conti *et al.* (1983) from a "semiquantitative" study of the Balmer-Pickering decrement. No clear correlation between hydrogen detection and spectral subtype could be established: stars with hydrogen and stars without detectable hydrogen are found among both, the WNE ("early") as well as the WNL ("late").

This picture drastically changes when the hydrogen detection is not correlated with the subtype, but instead with the stellar parameters as obtained by a detailed spectral analyses with our elaborate models (Schmutz *et al.*, 1989). Now we find a clear separation between two groups: the "cool" stars with $T_* \approx$ 35 kK exhibit hydrogen, while the "hot" stars ($T_* > 60$ kK) do not. WR136 is intermediate in temperature and in hydrogen abundance. Some of those stars classified as "early" subtypes are actually "cool", and just these stars are found to show hydrogen.

We now apply our model calculations for a precise analysis of hydrogen abundances. For that purpose we extended our model code for a fully consistent treatment of line blends. We perform a "fine analysis" of the helium spectrum, giving special weight to the fit of those He II Pickering lines which are not blended by hydrogen. Subsequently, the theoretical profiles of those He II lines which coincide with hydrogen Balmer lines are compared with the observation. The best fit yields the stellar parameters (R_*, T_*, $\dot{M}$, v_∞) and the hydrogen mass fraction, β_H (Table 1).

The hydrogen mass fractions obtained for WR40 and WR128 ($\beta_H \approx 20\%$) agree well with theoretical predictions for a post-RSG evolution. WR136 with its smaller value ($\beta_H = 6\%$) appears as a link to the "hot" WN stars in which hydrogen is not detectable. WR22 is either in pre-RSG stage or represents the result of binary evolution.

Table 1. Fine Analyses Including Hydrogen

	WR 40	WR 128	WR 22	WR 136
Subtype	WN8	WN4	WN7abs	WN6
T_*/kK	31.2	37	31	51
$R_*/R_\odot$	18.	5.3	30	6.0
$\log\{\dot{M}/(M_\odot\,yr^{-1})\}$	-4.05	-5.0	-4.32	-3.85
v_∞/(km/s)	1000	2000	1500	1700
$\log L/L_\odot$	5.4	4.7	5.9	5.5
β_H [%]	16 ± 5	20 ± 10	40 ± 5	6 ± 3

References

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