THE NITROGEN SPECTRA OF WN STARS: THE WN6 "STANDARD" STAR HD 192163 (WR136)

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Hitherto our quantitative analyses of WR spectra [2][5] have been based on pure-helium models [1][6]. Now we further improved our non-LTE calculations by including a complex model atom of nitrogen (90 energy levels, 351 line transitions; with low-temperature dielectronic recombination) into our model atmospheres in order to synthesize adequately the spectra of WN subtypes (Wessolowski *et al.*, in preparation). Together with the nitrogen (the most important "metal" in WN atmospheres), we introduced an improved temperature structure into our model calculations [3], now accounting for non-grey radiative equilibrium instead of the grey approximation applied so far. Moreover we took into account the line overlap of the considered elements (*here:* helium, nitrogen) and also their blanketing effects on the continuous radiation field.

Theoretical line profiles of nitrogen are compared with the observed spectrum of HD 192163 (alias WR136), a well-known WN6 "standard" star (Table 1). Most of the equivalent widths of the observed nitrogen lines can be reproduced within a factor of 2 to 3, but only by two slightly different models (Model 1: $T_* = 50kK$ and $R_* = 6.0R_\odot$, Model 2: $T_* = 60kK$ and $R_* = 5.5R_\odot$; both models with $log[\dot{M}/(M_\odot yr^{-1})] = -3.85$, $v_\infty = 1700\,km/s$ and a nitrogen abundance $\beta_N = 1.5\%$ by mass).

TABLE 1. Equivalent widths [Å] of nitrogen lines for HD 192163 (WN6)

nitrogen	N III	N IV				N V		
lines	λ4640	λ1486	λ1718	λ3480	λ4058	λ1240	λ4610	λ4944
Observed	79	29	34	60	38	10	10	3
Model 1	30	58	10	12	28	3	1	2
Model 2	13	81	15	41	43	11	1	3

Altogether these results confirm the tendencies of Hillier's cool wind model for the WN5 star HD 50896 [4]. Remaining problems may be attributed to the very complex model atom and minor uncertainties in the stellar parameters and the temperature structure.

References:

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