N32c Sodium Abundance Determination of A-Type Stars from Na I D Lines

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An extensive non-LTE abundance analysis based on Na I 5890/5896 doublet lines was carried out for a large unbiased sample of $\sim$ 120 A-type main-sequence stars (including 23 Hyades stars) covering a wide $v_{\rm e} \sin i$ range of $\sim$ 10–300 km s^{-1}, with an aim to examine whether the Na abundances in such A dwarfs can be reliably established from these strong Na I D lines. The resulting abundances ([Na/H]$_{58}$), which were obtained by applying the $T_{\rm eff}$-dependent microturbulent velocities of $\xi \sim$ 2–4 km s^{-1} with a peak at $T_{\rm eff} \sim$ 8000 K (typical for A stars), turned out generally negative with a large diversity (from ~ -1 to ~ 0), while showing a sign of $v_{\rm e} \sin i$-dependence (decreasing toward higher rotation). However, the reality of this apparently subsolar trend is very questionable, since these [Na/H]$_{58}$ are systematically lower by $\sim$ 0.3–0.6 dex than more reliable [Na/H]$_{61}$ (derived from weak Na I 6154/6161 lines for sharp-line stars). Considering the large ξ-sensitivity of the abundances derived from these saturated Na I D lines, we regard that [Na/H]$_{58}$ must have been erroneously underestimated, suspecting that the conventional ξ values are improperly too large at least for such strong high-forming Na I 5890/5896 lines, presumably due to the depth-dependence of ξ decreasing with height. The nature of atmospheric turbulent velocity field in mid-to-late A stars would have to be more investigated before we can determine reliable sodium abundances from these strong resonance D lines.