Erratum: Photospheric silicon abundances of upper main-sequence stars derived from Si II 6347/6371 doublet lines

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In the article [CAOSP, 52, 5–31 (2022); DOI: 10.31577/caosp.2022.52.1.5], Si abundances of 120 late A- through late B-type stars were determined by conducting a non-LTE analysis on Si II doublet lines at 6347 and 6371 Å. It has recently revealed, however, that the non-LTE corrections (Δ) and abundances ($A^{\rm N}$) derived therein were not correct because of an inadvertently erroneous treatment in the non-LTE calculation program. Specifically, the overionization effect of Si II atoms (acting to weaken Si II lines or shifting Δ towards the positive direction) was underestimated by this mistake. As a consequence, Δ and $A^{\rm N}$ obtained in that paper were more or less undervalued, and this error becomes progressively more significant with an increase in $T_{\rm eff}$ (as the dominant ionization stage of Si atoms changes from Si II to Si III).

Therefore, the equivalent widths of Si II 6347/6371 lines for each star were reanalyzed based on the corrected non-LTE calculations. The resulting new values of Δ and $A^{\rm N}$ are shown in Figs. 11a and 11b, which should be compared with Figs. 4b and 4c of the original article, As seen from these figures, while Δ(old) values range between ~ -0.4 to ~ 0.0, Δ(new)s are somewhat raised upward by ~ 0.2 dex on the average (i.e., ranging between ~ -0.2 and $\sim +0.2$). Since the gradual $T_{\rm eff}$-dependent effect is not so significant in the relevant range of $7000 \lesssim T_{\rm eff} \lesssim 13000$ K, the impact of applying new Δ is almost the overall raise of $A^{\rm N}$ (or [Si/H]) by ~ 0.2 dex, which is not so important as compared to the star-to-star dispersion of the abundances (~ 1 dex). Accordingly, the main conclusion of the article (regarding the Si abundances of late A- to late B-stars) is not essentially affected by the revised non-LTE calculations.

In the meanwhile, the inadequate non-LTE calculations had a crucial influence upon the consequence of the Appendix of the paper, where the non-LTE effect on the formation of Si II lines in B-type stars in general (covering $T_{\rm eff}$ up to ~ 20000 K) was passingly examined in comparison with Mashonkina's (2020, MNRAS, 493, 6095) study, because the differences (increasing with $T_{\rm eff}$) become considerably large at such a high-$T_{\rm eff}$ regime. This situation is illustrated in Fig. 12, which is the revised version of the original Fig. 10. As shown in Fig. 12a, the degree of overionization ($l_0^{\rm NLTE}/l_0^{\rm LTE} < 1$) is considerable and progressively enhanced with $T_{\rm eff}$ at $T_{\rm eff} \gtrsim 10000$ K, while such a tendency was absent in the old Fig 10a. As a result, the behavior of new Δ_{6371} (non-LTE correction for Si II 6371; red solid line in Fig. 12c) is markedly different as compared to the previous result (black dotted line in Fig. 12c); that is, it is larger by ~ 0.2–0.5 dex and turns into positive already around $T_{\rm eff} \sim 13000$ K.

It was once stated in the Appendix that a reasonable non-LTE Si abundance could be obtained for the B3 IV star ι Her ($T_{\rm eff} \simeq 17500$ K) due to an application of $\Delta_{6371} \sim -0.1$ dex, in contrast to Mashonkina's appreciably positive Δ_{6371} (+0.67) yielding an unacceptably large non-LTE Si abundance. However, this conclusion was wrong, because such a slightly negative Δ_{6371} was fortuitously derived by incorrect non-LTE calculations. The problem of an unreasonably high non-LTE Si abundance for ι Her from Si II 6347/6371 lines still remains unsettled also in the author's non-LTE calculations. This means that much more investigation is further required towards correctly understanding the mechanism of Si II line formation in B-type stars.

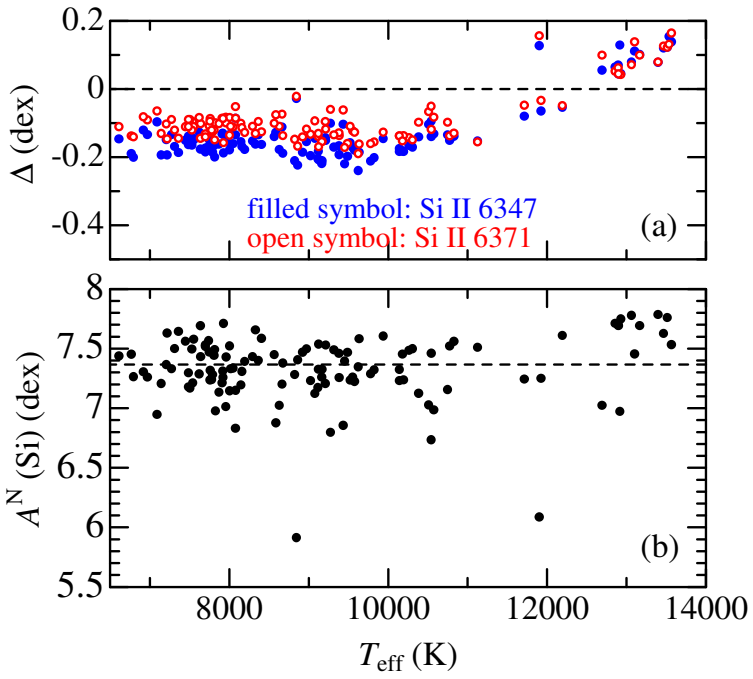

Figure 11. (a) Non-LTE corrections for Si II 6347 (Δ_{6347}, filled symbols) and Si II 6371 (Δ_{6371}, open symbols), plotted against $T_{\rm eff}$. (b) $A^{\rm N}$(Si) (non-LTE Si abundance derived by averaging those of Si II 6347/6371 lines), plotted against $T_{\rm eff}$. Note that panels (a) and (b) are the revised Fig. 4b and Fig. 4c in the original article.

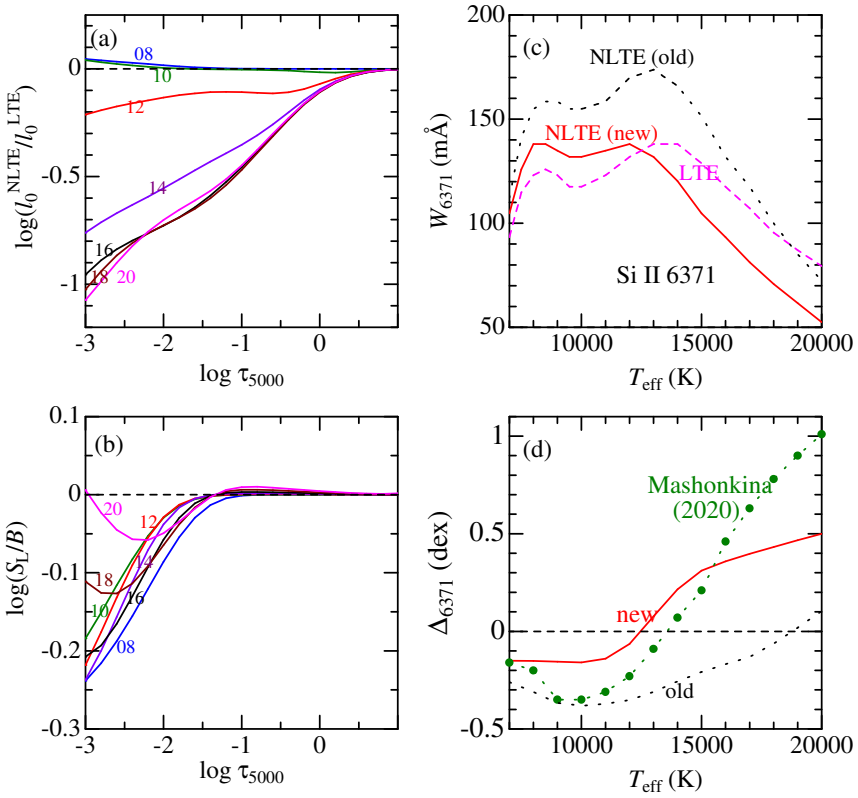

Figure 12. Behaviors of the non-LTE effect on Si II lines in B-type stars. This figure is the revised version of Fig. 10 in the original paper. See the caption therein for more details. (a) The non-LTE-to-LTE line-center opacity ratio (vs. τ_{5000}), (b) $S_{\rm L}/B$ ratio (vs. τ_{5000}), (c) non-LTE and LTE equivalent widths for Si II 6371 (vs. $T_{\rm eff}$), and (d) non-LTE correction for Si II 6371 (vs. $T_{\rm eff}$). In panels (c) and (d), the old (wrong) results are also shown by black dotted lines for comparison.