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Effect of atomic parameters on determination of aluminium abundance in atmospheres of late-type stars

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Abstract

We study the effect of the photoionization cross sections for the ground state of Al I on the inferred aluminium abundance in stellar atmospheres. We match the theoretical and observed line profiles of the resonance λλ 3944.01, 3961.52 Å and subordinate λλ 6696.03, 6698.68 Å doublets in high-resolution spectra of the metal-poor solar-type stars HD22879 and HD201889. We determine the parameters of these stars from their photometric and spectroscopic data. Our computations show that the profiles can be matched and a single aluminium abundance inferred simultaneously from both groups of spectral lines only with low photoionization cross sections (about 10-12 Mb). Larger cross sections (about 58-65 Mb) make such fits impossible. We therefore conclude that small photoionization cross sections should be preferred for the determination of aluminium abundances in metal-poor stars. We redetermine the aluminium abundances in the atmospheres of halo stars. The resulting abundances prove to be lower by 0.1-0.15 dex than our earlier determinations which does not affect the conclusions based on our earlier estimates. In particular, the NLTE [Al/Fe]-[Fe/H] dependence, on the whole, agrees only qualitatively with the results of theoretical predictions. Therefore further refinement of the theory of nuclear synthesis of aluminium in the process of the chemical evolution of the Galaxy remains a task of current importance. © 2014 Pleiades Publishing, Ltd.

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Keywords

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