

ABOUT COMPILED CATALOGUE OF SPECTROSCOPICALLY DETERMINED α -ELEMENTS ABUNDANCES FOR STARS WITH ACCURATE PARALLAXES

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ABSTRACT. We present a new version of the compiled catalogue of nearby stars for which was published the spectroscopically determined effective temperatures, surface gravities, and abundances of iron, magnesium, calcium, silicon, and titanium. Distances, velocity components, galactic orbital elements, and ages was calculated for all stars. The atmospheric parameters and iron abundances were found from 4700 values in 136 publications, while relative abundances of alpha-elements were found from 2800 values in 81 publications for ≈ 2000 dwarfs and giants using a three-step iteration averaging procedure, with weights assigned to each source of data as well as to each individual determination and taking into account systematic deviations of each scale relative to the reduced mean scale. The estimated assumed completeness for data sources containing more than five stars, up to late April 2007, exceeds 90%. For the vast majority of stars in the catalogue, the spatial-velocity components were derived from modern high-precision astrometric observations, and their Galactic orbit elements were computed using a three-component model of the Galaxy, consisting of a disk, a bulge, and a massive extended halo. Ages was determined for dwarfs and subgiants using Yale isochrones 2004. For this purpose the original codes was developed, based on interpolation with the 3D-spline functions of theoretical isochrones, and with subsequent interpolation in metallicity and abundances of α -elements.

Key words: Galaxy (Milky Way), stellar chemical composition, thin disk, Galactic evolution.

The various published abundances of an element for a given star often differ quite appreciably, even when the spectra reduced by different authors are of similarly high quality. If several abundance values are available for the same star, they can simply be averaged. However, when an abundance is presented in only one paper, the possibility of systematic differences must

be considered. We collected all available lists (with ≥ 5 stars) of relative abundance estimates of four α -elements ($[\text{Mg}/\text{Fe}]$, $[\text{Ca}/\text{Fe}]$, $[\text{Si}/\text{Fe}]$, $[\text{Ti}/\text{Fe}]$) for field stars from high-resolution spectra with high signal-to-noise ratios published after 1989. We estimate the completeness of the abundances published for solar-vicinity stars up through April 2007 to be better than 90%. The raw material for this study were 81 publications containing 2800 α -element-abundance determinations for ≈ 2000 stars.

To derive reliable atmospheric parameters and abundances, we applied three-step iterative technique for compiling data, which in detail described in the paper (Borkova, Marsakov, 2005), with awarding of weight both to each source and to each determination of the averaged value. Stellar effective temperatures, metallicities, and relative abundances of α -elements were leaded to scales of Edvardsson et al. (1993). The surface gravities was leaded to scale of Gratton et al. (2003), where they was determined on the basis of trigonometric parallaxes. We found it necessary to differentiate between the two metallicity groups because the uncertainties in all the parameters are considerably larger for the metal-poor stars.

The first step of averaging procedure was a simple mean. Our analysis shows that the scatter of the deviations and the systematic offset of individual atmospheric parameters and abundance determinations relative to the calculated mean values vary from list to list and also depend on metallicity. To take these small but systematic trends into account, we divided each list into two metallicity ranges at $[\text{Fe}/\text{H}] = -1.0$ and calculated the mean deviations for these ranges. We then corrected all the individual determinations of each parameter for these biases. These corrections leave the determined parameter for stars present in several lists virtually unchanged. However, if a star's parameter was determined in a single study only, the correction will strongly affect the final determined parameter.

The next step after correcting for systematic biases was to determine weights for the data sources and cal-

Table 1: Internal accuracy of final atmospheric parameters and relative abundances of α -elements for catalogue stars

[Fe/H] range	T_{eff} K $^{\circ}$	$\log g$	ε [Fe/H] dex	ε [Mg/Fe] dex	ε [Ca/Fe] dex	ε [Si/Fe] dex	ε [Ti/Fe] dex
> -1.0	58	0.12	0.06	0.07	0.07	0.05	0.15
< -1.0	137	0.24	0.09	0.09	0.09	0.11	0.15

culate new weighted means. Each source was assigned a weight that was inversely proportional to the corresponding dispersion for the deviations in each of the metallicity ranges. In this case one and the same source could obtain different weight for each determined parameter. The lowest scatter for the higher metallicity range was found for the lists of Mashonkina et al. (2003), Edvardsson et al. (1993), and Jehin et al. (1999), and they were assigned unit weights. At lower metallicity range, the lowest scatter was shown by the lists of Nissen & Schuster (1997), Mashonkina et al. (2003) and Jehin et al. (1999). The lowest weights assigned to some of the lists were ≈ 0.2 . We then calculated a new weighted mean each parameter for each star taking into account the biases and weights assigned to the lists.

The next step was also a weight-assigning procedure, this time for individual parameter determinations. This procedure was intended to assign lower weights to initial values showing larger deviations. Clearly, such a procedure can work only if there are three or more values for the same star. When assigning the weights, we considered the mean absolute value of the deviations for all stars in the list containing the given value. As a result, this procedure assigns the lowest weights to the least-reliable determinations and enables us to obtain final values that are close to those given for most of the sources, with no single measurement rejected.

For all parameters, we estimated the uncertainties of the averages based on the scatter of the individual values about the final average for each star; i. e., from the agreement of the values obtained by the various authors. The corresponding uncertainties are presented in Table 1. All these estimates are close to the lower limits of the uncertainties for these parameters claimed by the authors.

We determined the distances to the stars using trigonometric parallaxes with uncertainties below 20%. In their absence we adopted the photometric distances, derived using uvby β photometric data. The uncertainty in photometric distances is usually claimed to be $\pm 13\%$.

We took the proper motions from the catalogs Hipparcos (1997), in their absence we adopted other background catalogs. spatial velocities and galactic orbital elements we computed the U , V , and W components

of the total spatial velocity relative to the Sun for stars with distances, proper motions, and radial velocities. The main contribution to the uncertainties in the spatial velocities comes from the uncertainties in the distances, rather than the uncertainties in the tangential and radial velocities. For mean distance uncertainties of 15% and the mean distance from the Sun of the sample stars, ≈ 60 pc, the mean uncertainty in the spatial velocity components is $\approx \pm 2$ km/s.

We calculated the Galactic orbital elements by modeling 30 orbits of each star around the Galactic center using the multi-component model for the Galaxy of Allen & Santillan (1991), which consists of a disk, bulge, and extended massive halo.

Ages were determined on the basis of Yale isochrones (2004) approximately for 1000 dwarfs and subgiants. For this purpose was developed the original procedure of 3D-spline interpolation of published theoretical isochrones. Procedure considers not only the metallicity of star, but also the content of α -elements in it.

The complete describing of the catalog will be published latter in Astronomical Repots.

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