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The RAdial Velocity Experiment: preparing the 6th Data Release chemical abundances with GAUGUIN

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Abstract. In the context of the Radial Velocity Experiment (RAVE, Steinmetz *et al.* 2006), we present chemical abundances derived with the pipeline GAUGUIN. Based of 520 701 RAVE stars with medium resolution (R∼ 7 500) spectra and stellar atmospheric parameters of the fifth Data Release, the analysis is performed around the infrared Ca-triple domain for 6 chemical elements: Mg, Ni, Si, Ti, Fe and Al. We discuss here the reliability of the chemical abundances provided by GAUGUIN, and the implications for the future Data Release 6 of the RAVE Survey. We also present elemental abundance patterns of Milky Way components based of kinematical criteria.

Keywords. stars: abundances. techniques: spectroscopic.Galaxy: stellar content

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1. Chemical abundances and its validations

In the context of the RAVE Survey, we present a new elemental pipeline designed for the RAVE spectra, GAUGUIN (Guiglion *et al.* 2016, Guiglion *et al.* in prep.). From the 5th RAVE Data Release (Kunder *et al.* 2017), we select 192 181 stars with the best calibrated atmospheric parameters ($T_{\rm eff}$, log(g), [M/H]) and individual chemical abundances for $S/N > 20$. The RAVE DR5 atmospheric parameters have been calibrated using seismic gravities of 87 stars from K2 (Valentini *et al.* 2017). The RAVE spectra (R∼ 7 500) cover the infrared calcium triplet ($\lambda \in [8410 - 8795] \AA$), with spectral features for Fe, Mg, Si, Ti, Ni and Al abundances derivation. To do so, we took advantage of the automatic optimization pipeline GAUGUIN, based on a 3D synthetic spectra grid $\{T_{\rm eff}$, log(g), [M/H]$\}$ (Kordopatis *et al.* 2011) and a Gauss-Newton algorithm (Bijaoui *et al.* 2012). Propagating the errors of the atmospheric parameters and the line-to-line scatter, we provided for the first time errors on the RAVE chemical abundances. A total of 43×10^6 abundances have been computed in ~ 6 hours on a single core computer (1 850 abund/sec), leading to a homogeneous catalog containing Fe, Mg, Si, Ti, Ni & Al individual chemical abundances with associated errors for 192 181 RAVE stars. We compared our abundances with DR5 ones (Kunder *et al.* 2017). For giants with $S/N > 80$, the typical dispersions are 0.11 dex for Si, Fe & Al, 0.13 for Mg, while Ti & Ni show higher dispersion, 0.18 and 0.16 dex, respectively. Higher dispersion is observed for dwarfs. Thanks to comparisons with 135 stars of Soubiran *et al.* (2005) and Ruchti *et al.* (2011) observed with high resolution spectroscopy, we externally validated GAUGUIN abundances over a wide range of atmospheric parameters. The most reliable elements are Si, Fe & Al due to numerous or strong lines. Ni & Ti should be used only for cool giants at high S/N.

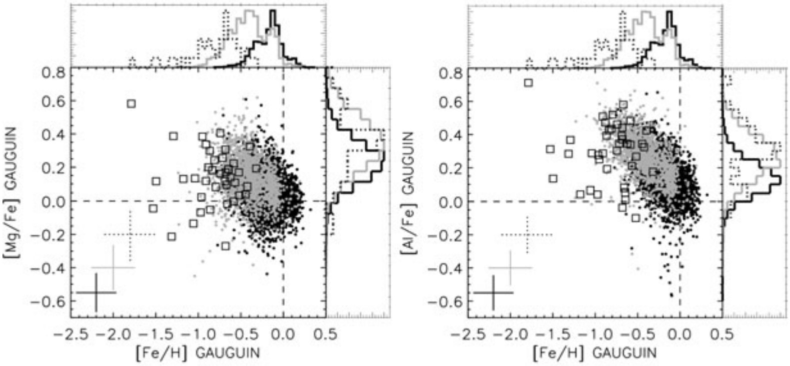

Figure 1. [Mg/Fe] & [Al/Fe] vs. [Fe/H] for the thin (black, filled circles and solid lines), dissipative collapse (grey, filled circles and solid lines) and *accretion* (black, squares and dotted lines) components. Abundance normalized distributions and typical errors are presented.

2. Abundance-kinematical properties of the Milky Way components

To characterize the GAUGUIN abundance patterns in the thin disc, thick disc and halo, we followed the same kinematical approach as Boeche *et al.* (2013). We selected stars with $S/N < 75$ and the best GAUGUIN abundances ($e_{\mathrm{Fe,Mg,Al}} < 0.35\,\mathrm{dex}$). For giants with TGAS proper motions (Lindegren *et al.* 2016) and DR5 distances, were computed the eccentricities (e), azimuthal velocities (V_ϕ) and maximum vertical amplitude ($\mathrm{Z}_{\max}$). We divided our dataset in three subsamples: *thin disc* component ($e < 0.25$, $\mathrm{Z}_{\max} < 0.8\,\mathrm{kpc}$), *dissipative collapse* component ($e < 0.25$, $\mathrm{Z}_{\max} > 0.8\,\mathrm{kpc}$, $\mathrm{V}_\phi > 40\,\mathrm{km\ s}^{-1}$) and *accretion* component ($\mathrm{V}_\phi < 40\,\mathrm{km\ s}^{-1}$). In Figure 1, we first see that these components clearly have separated iron distributions. The *dissipative* component shows by higher [Mg,Al/Fe] ratios compared to the the *thin disc* one, besides substantial overlap. We notice a flatter pattern of [Si/Fe] with [Fe/H], consistent with previous studies (*e.g.* Mikolaitis *et al.* 2014). The *dissipative* component overlaps weakly the *thin disc* for $[\mathrm{Fe/H}] > 0$. Mainly with $[\mathrm{Fe/H}] < -0.5\,\mathrm{dex}$, the *accretion* component is consistent with halo chemical pattern (*e.g.* Nissen & Schuster 2010). The clear decrease of [Al/Fe] with [Fe/H] in both *thin disc* and *dissipative* components is consistent with literature (*e.g.* Smiljanic *et al.* 2016). We conclude that GAUGUIN reproduces the abundance patterns of Mg & Al in the main three Milky Way components. The pipeline is then reliable for scientific applications, and will derive chemical abundances and errors for stars in the 6th RAVE Data Release.

References

Bijaoui, A., Recio-Blanco, A., de Laverny, P., *et al.* 2012, *Stat. Met.*, 9, 55.
Boeche, C., Chiappini, C., Minchev, I., *et al.* 2013, *A&A*, 553, 19.
Guiglion, G., de Laverny, P., Recio-Blanco, A., *et al. A&A*, 2016, 595, A18.
Kordopatis, G., Recio-Blanco, A., de Laverny, P., *et al.* 2011, *A&A*, 535, A106.
Kunder, A., Kordopatis, G., & Steinmetz, M., *et al. AJ*, 2017, 153, 75.
Lindegren L., Lammers, U., Bastian, U., *et al.*, 2016, *A&A*, 595, A4.
Mikolaitis, S., Hill, V., Recio-Blanco, A., *et al.* 2014, *A&A*, 572, A33.
&Nissen P. E. & Schuster W. J., 2010, *A&A*, 511, L10.
Ruchti, G. R., Fulbright, J. P., Wyse, R. F. G., *et al.* 2011, *ApJ*, 737, 9.
Soubiran, C. & Girard, P., 2005, *A&A*, 438, 139.
Smiljanic, R., Romano, D., Bragaglia, A., *et al.* 2016, *A&A*, 589, A115.
Steinmetz, M., Zwitter, T., & Siebert, A., *et al.* 2006, *AJ*, 132, 1645.
Valentini, M., Chiappini, C., & Davies, G. R, *et al.* 2017, *A&A*, 600, A66.